

REF# 00602
67-1001

GEOSCIENCE

BRANCH

NO. 20

MGG 09005001

INFORMAL
MANUSCRIPT
REPORT
NO. 0-4-64

TITLE

INVESTIGATION OF THE APPLICATION OF
STANDARD SOIL MECHANICS TECHNIQUES
AND PRINCIPLES TO BAY SEDIMENTS

AUTHOR

GEORGE H. KELLER

DATE

APRIL 1964

This manuscript has a limited distribution, therefore
in citing it in a bibliography, the reference should be
followed by the phrase UNPUBLISHED MANU-
SCRIPT.

MARINE SCIENCES DEPARTMENT
U. S. NAVAL OCEANOGRAPHIC OFFICE
WASHINGTON, D. C. 20390

MGG 0 9 0 0 5 0 0 1**ABSTRACT**

In recent years considerable interest has been shown in the engineering properties of submarine sediments. To date, studies of these properties have primarily been based on procedures and techniques used in the field of soil mechanics for foundation investigations on land. This study was undertaken to investigate the feasibility of using these soil mechanics procedures in conjunction with submarine sediments. Bottom samples were collected from St. Andrew Bay, Florida and analyzed for their mass physical properties using standard soil mechanics procedures. The influence of sampling, using oceanographic techniques, on the engineering properties is considered. Predictions as to the penetration of various shaped cement blocks, based on standard bearing capacity formulae using the data derived from the laboratory tests, were made. These predictions were then compared with actual measurements made on the blocks after they were placed on the bay floor. The problem of core shortening and the accuracy of predictions based on these formulae are discussed.

MGG 09005001

TABLE OF CONTENTS

	Page
Introduction	1
Purpose of Study	1
Site	2
Procedure	2
Observations	4
Interpretations	16
Conclusions	23
References	25

APPENDICES

A. Dimensions and Weights of the Cement Blocks	27
B. Summary Sheets of Mass Physical Properties of Bottom Sediments and Explanation of Data Pages	29

FIGURES

1. Bottom Topography and Sample Locations	3
2. Core Length Related to Corer Penetration	6
3. Parameters Versus Depth for Site 2, Core 3	11
4. Parameters Versus Depth for Site 1, Core 4	12
5. Parameters Versus Depth for Site 3, Core 5	13
6. Parameters Versus Depth for Site 4, Core 3	14
7. Bearing Capacity Versus Depth and Predicted Block Penetration	15
8. Predicted and Actual Penetration of Circular and Square Blocks, Site 1	19
9. Predicted and Actual Penetration of Rectangular Block, Site 1	20
10. Predicted and Actual Penetration of Circular and Square Blocks, Site 2	21
11. Predicted and Actual Penetration of Rectangular Block, Site 2	22

TABLES

I. Sediment Characteristics by Sediment Type	7
II. Characteristics of Engineering Properties by Sediment Type	8
III. Mass Physical Properties	9
IV. Interrelationships of Significant Sediment Characteristics by Rank and Sediment Strength	17
V. Penetration Factors	23

MGG09005001

INVESTIGATION OF THE APPLICATION OF STANDARD SOIL MECHANICS TECHNIQUES AND PRINCIPLES TO BAY SEDIMENTS

INTRODUCTION

In recent years, marine geologists have been devoting more effort to investigating the engineering properties of submarine sediments in an attempt to understand the sedimentation and geological history of the ocean basins, as well as to provide engineering data for various installations to be placed on the sea floor. Some of the earlier studies were conducted by Trask and Rolston (1950), Hamilton (1950), McClelland (1956), Fisk and McClelland (1959), and Moore (1959). More recently Richards (1961, 1962) has reported in detail on the engineering properties of 35 cores collected from various ocean basins. Several others have, in recent years, reported on different aspects of these engineering properties. However, to date, for his investigation of the engineering properties of submarine sediments, the marine geologist has had to rely on the techniques and principles of soil mechanics that were developed for use in foundation studies on land.

Some individuals working in the field of submarine soil mechanics have felt that the engineering data derived from laboratory tests are not truly representative of the in situ conditions. Sampling techniques are crude and undoubtedly alter some of the mass physical properties by both compaction and sediment disturbance. Sediment cores are often shorter than the interval penetrated by the core barrel. This poses the problem of relating the length of the cored sample to the interval from which it was taken. Withdrawal of the sample from its surrounding pressures also may result in a difference between the in-place and the laboratory values. This difference is probably more significant in areas of great water depth. In their study of some Norwegian clays Cadling and Odenstad (1950) reported variations of up to 3.5 psi between shear strength measurements made in the laboratory and similar tests made in the field.

PURPOSE OF STUDY

As a result of these problems, a study was undertaken to determine the validity of applying standard soil mechanics techniques and principles to soft submarine sediments. The purpose of this investigation was as follows: To collect sediment cores from a bay, make the necessary engineering tests, calculate the sediment bearing capacity, predict the amount of sinking of various shaped concrete blocks into the sediment, observe the actual penetration of the blocks, and relate the observed penetration values to the predicted values. These data then would serve to indicate if a problem existed and, hopefully, what modifications might be applied to the present principles in order to more accurately determine the engineering properties of submarine sediments.

MGG 0 9 0 0 5 0 0 1

SITE

St. Andrew Bay, Florida was selected as the site for these studies because of the availability of the necessary support vessels and divers from the nearby U. S. Navy Mine Defense Laboratory. St. Andrew Bay is an estuary directly connected with the Gulf of Mexico and located on the northern gulf coast of Florida (Fig. 1). Mean water depth within the bay is 17 feet. Hydrographic conditions in the bay are primarily dependent on the Gulf of Mexico, but are influenced also by local drainage into the area (Ichiye and Jones, 1961). Waller (1961) described the sediment distribution within the bay as consisting mainly of fine to medium sands (0.25mm to 0.125mm) along the margins grading to silts and clays (0.03mm to 0.01mm) in the deeper central portions. Sorting is progressively poorer toward the center of the bay.

PROCEDURE

Eight sediment cores ranging from 100 to 231 cm. in length were collected with a Hydro-Plastic corer (Richards and Keller, 1961) from four sites (Fig. 1). Normal oceanographic coring procedures were used during the sampling program (U. S. Navy Hydrographic Office, 1955). Six cores were taken without a piston and two with a piston. The cores were kept in a vertical position from the time of collection until they were analyzed in the laboratory, approximately 2 days later. Standard laboratory soil mechanics tests were made on the samples for the determination of water content, bulk density, Atterberg limits, grain specific gravity, and shear strength. All shear strength measurements were made with a vane apparatus. In addition, textural characteristics, carbonate and organic carbon content, and the clay mineralogy were determined. X-ray diffraction was used for the identification of the clays.

Bearing capacity calculations, based on the shear strength and bulk density data obtained from the laboratory tests, were made using the following standard formulae for objects with rectangular, square, and circular footings:

Rectangular Footing

$$q_u = c(N_c) + \gamma d(N_q) + \gamma b(1/2N\gamma) \quad (1)$$

Circular Footing

$$q_u = 1.3c(N_c) + \gamma d(N_q) + 0.6\gamma b(1/2N\gamma) \quad (2)$$

Square Footing

$$q_u = 1.3c(N_c) + \gamma d(N_q) + 0.8\gamma b(1/2N\gamma) \quad (3)$$

Where: N_c , N_q , N_y , are called bearing-capacity factors and are equal to 5.7, 1.0, and 0, respectively, when the angle of internal friction is zero; c is cohesion; γ is sediment buoyant weight; d is depth in the sediment; and b is the width of the footing (Taylor, 1948, p. 575-580). The angle of internal friction is assumed to be zero for the sediments discussed in this report. This assumption leads to the elimination of the last factor in all equations and (2) and (3) become the same.

MEASUREMENTS
MCC 09005001

6

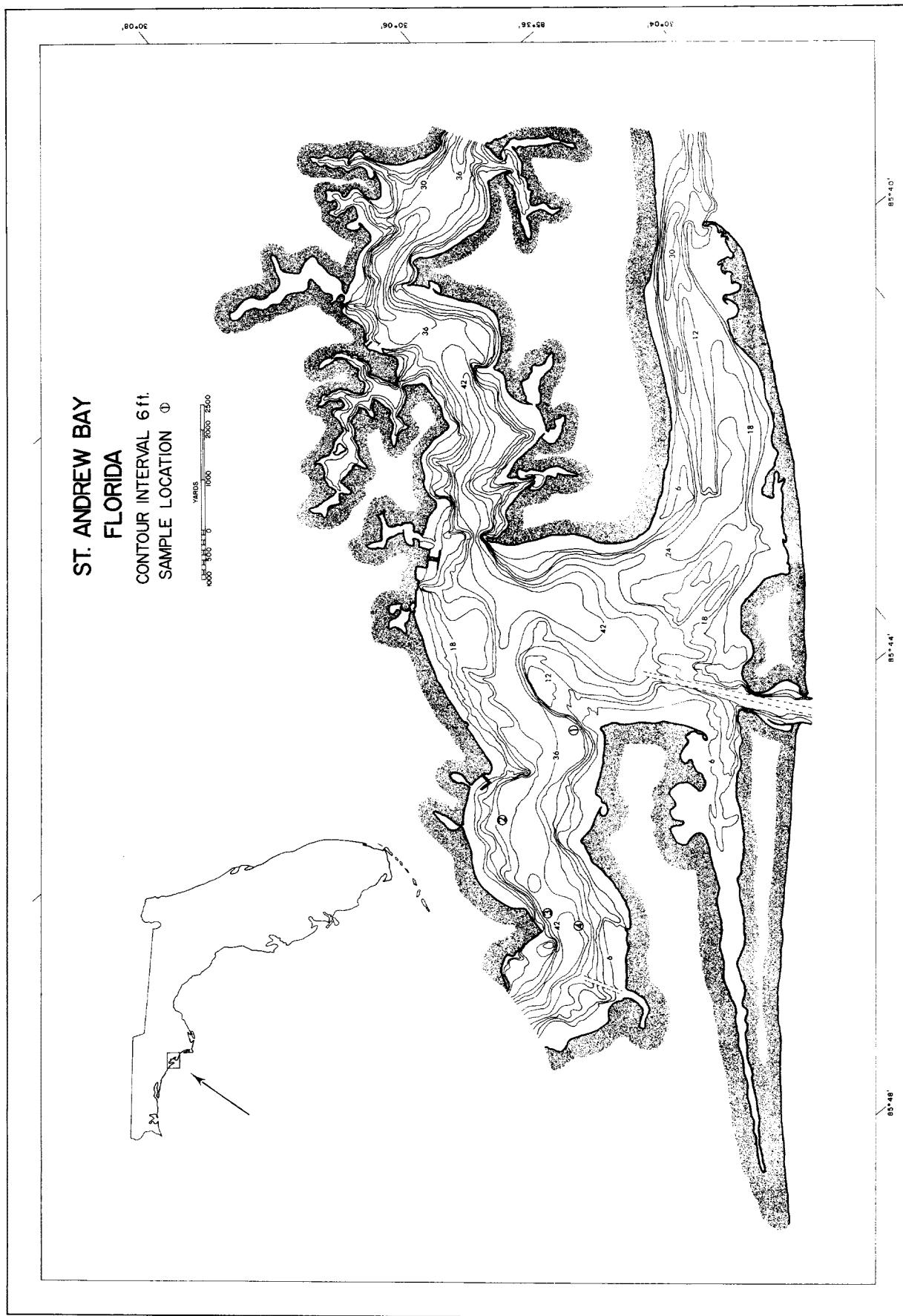


FIGURE 1. BOTTOM TOPOGRAPHY
AND SAMPLE LOCATIONS

MGG 09005001

Three concrete blocks, each weighing approximately 4000 pounds in air, with varying shapes (rectangular, square, and circular bases) were built for these tests. See appendix A for the exact dimensions and weights of the blocks. Utilizing the sediment bearing (load per square inch) of each block, predictions were made as to how far each block would sink into the sediment. The blocks were lowered at a slow rate so that they entered the sediment with essentially no impact velocity. All penetration measurements were made by SCUBA divers within a period of 5 minutes after each block was planted.

OBSERVATIONS

Core shortening occurred in each instance when the piston was not used in the coring tool. A check valve was not used in order to reduce any possible restriction of water flow through the barrel as the corer penetrated the sediment. Prior to withdrawal of the corer from the bottom, divers capped the top, and as the lower end of the barrel emerged from the sediments it too was capped, reducing the chances for sample loss. Corer penetration measurements also were made by the divers. Recovery ratios $\frac{\text{core length}}{\text{corer penetration}} \times 100$ ranged from 33 to 73 percent for the gravity cores.

It is generally agreed that core shortening does occur when a piston is not used. There are, however, differing opinions as to how the shortening occurs and how the cored increment is related to its in-place increment:

Case I. Core length is equal to the same depth below the water-sediment interface independent of how far the corer penetrated the sediment. The length of core represents the same increment in place.

Case II. A linear relationship exists between the length of recovered core and the depth of penetration; each increment of the core represents a larger increment in place. As the corer enters the bottom, compaction of the sediment takes place from the top to the bottom of the core. The recovery ratio is always less than 100 percent. Emery and Dietz (1941, p. 1706-1711) demonstrated this interpretation with various model and field tests. This interpretation is most commonly accepted for gravity corers.

Case III. According to the studies of Hvorslev (1949, p. 105-119), little if any core shortening occurs down to a depth of 40 to 75 cm, depending on the dimensions and characteristics of the corer. Below this depth, the sample increment represents a larger, in-place, increment, and shortening is proportional to the additional distance penetrated. Richards (1961, p. 13) pointed out that the amount of core shortening is probably a function of corer design and that cores with longer increments of 100 percent recovery ratios could be obtained with improved engineering designs. Richards and Keller (1961) noted that in a core collected with a plastic-barrel corer there was no indication that shortening had occurred in the upper 50 cm. of the sample.

MGG 09005001

Hamilton (1960, p. 317) favors the latter interpretation, and he is presently investigating the problem of core shortening in detail (personal communication). A graphic presentation of these interpretations is shown in Figure 2.

The piston cores had recovery ratios of 64 to 84 percent. The sediments were very soft, nearly a suspension, at the water-sediment interface which made it difficult to determine the depth to which the tripping weight penetrated before releasing the corer. It is apparent that in both cases the corer penetrated some distance into the bottom before the piston was activated. Studies by Kallstenius (1958) indicate that in some circumstances the assumption that piston submarine core recovery ratios are 100 percent is questionable.

Sediment characteristics and engineering properties were determined for the eight cores. The sediment type classification used in this study is a modification of Shepard's tetrahedron diagram (Shepard, 1954) derived by Richards (1961, p. 11). For the textural analysis the samples were wet-sieved through a 0.062 mm. screen and fractionated into Wentworth intervals by standard sieve and pipette methods as outlined by Krumbein and Pettijohn (1938). Table I shows the sedimentary characteristics as related to the various sediment types found in St. Andrew Bay. Generally, as might be expected in this environment, the sediments are poorly sorted and skewed toward the coarse material.

Calcium carbonate content was determined by titrating the calcium ion by E.D.T.A. (ethylenediaminetetraacetic acid) ... as described by Turekian (1956). Calcium carbonate varied from 5 to 23 percent with the larger percentages occurring in the finer material. Shell fragments constituted most of the calcium carbonate.

Organic carbon content was determined in accordance with the procedure outlined by Allison (1935). Percentages of organic carbon ranged from 1.72 to 3.88 with the high values also occurring in the finer sediments.

The engineering properties as related to the various sediment types are presented in Table II. These data indicate an increase in wet unit weight (bulk density), shear strength, grain specific gravity, and sensitivity with increasing grain size. Water content, porosity, and void ratio tend to decrease with increasing grain size. It must be emphasized that these are only generalizations, and considerably more data is required to determine if there is a real basis for these trends. These variations with sediment type are minor, and in some instances, similar variations might exist in areas of the same sediment types. The interrelationships of the different parameters must be considered in any attempt to predict the behavior of one parameter based on another.

Variations of the mass physical properties at the four sites is shown in Table III. The engineering properties indicate general agreement between sites 2 and 3 and sites 1 and 4. Slightly denser and stronger sediments were found at the latter sites. This relationship, however, is not indicated by the mechanical properties. The sediments are equally poorly sorted at all sites; however, they are finer at site 2. Skewness indicates that a slightly higher energy level may exist at site 3 in comparison to the other areas. Variation of these

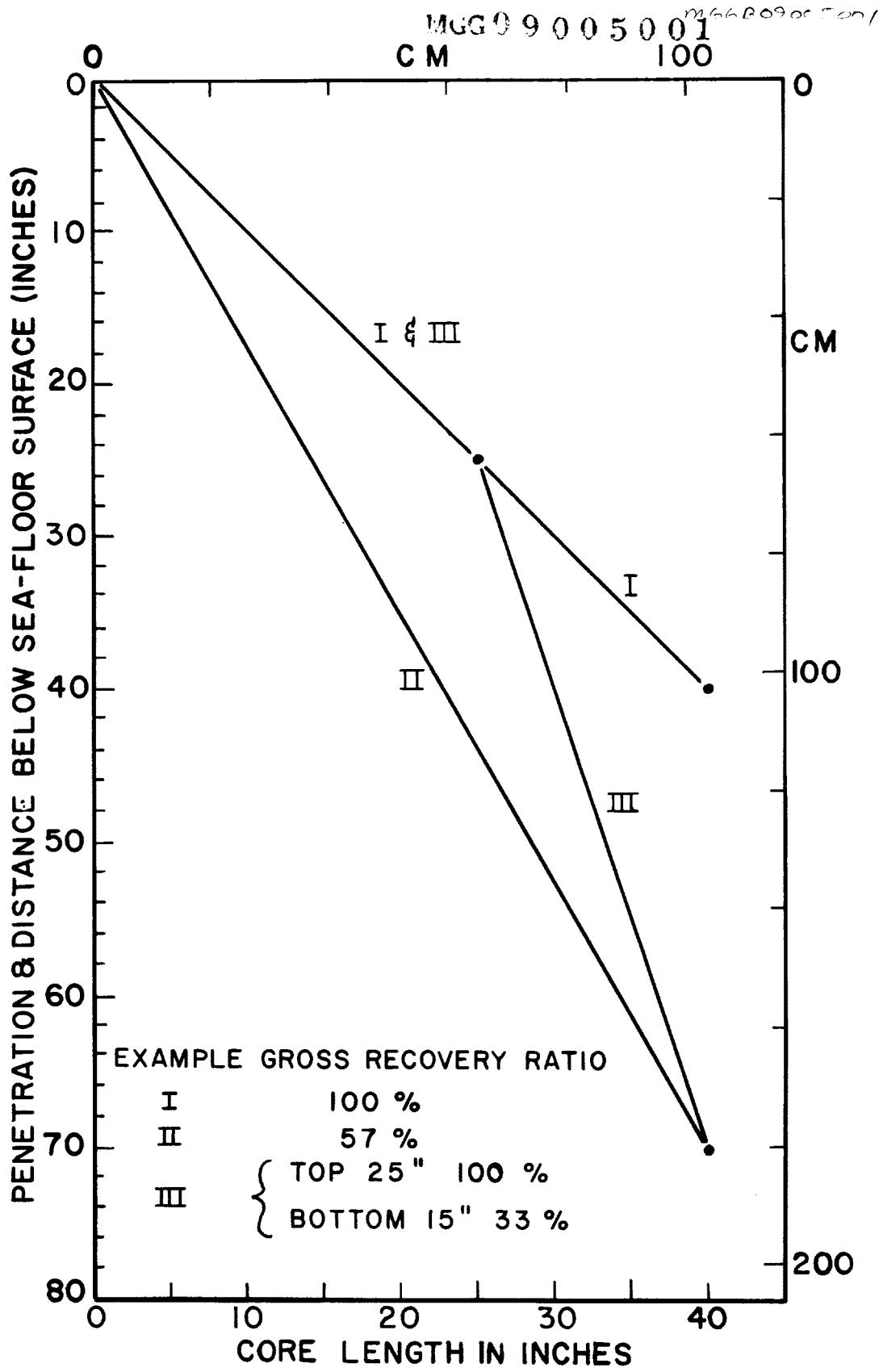


FIGURE 2. GRAPH SHOWING THREE WAYS TO RELATE CORE LENGTH TO CORER PENETRATION (After Richards, 1961, p.14)

MCG 09005001

TABLE I
SEDIMENT CHARACTERISTICS BY SEDIMENT TYPE (Total Core)

Sediment Type	Median Diameter	Sorting Coefficient	Skewness	CO_3	Organic Carbon
	Avg. Range μ	Avg. Range	Avg. Range	Avg. Range %	Avg. Range %
	* 12/	12/	12/	4/	4/
Silty Clay	<u>3</u> <u>2-5</u>	<u>6.5</u> <u>4.4-11.6</u>	<u>0.67</u> <u>0.33-0.36</u>	<u>19</u> <u>16-23</u>	<u>3.72</u> <u>3.32-3.88</u>
Clayey Silt	<u>6/</u> <u>8</u> <u>6-11</u>	<u>6/</u> <u>4.5</u> <u>4.2-5.4</u>	<u>6/</u> <u>0.55</u> <u>0.42-0.70</u>	-	-
Clayey Mud	<u>17/</u> <u>8</u> <u>3-18</u>	<u>17/</u> <u>11.0</u> <u>7.1-15.3</u>	<u>17/</u> <u>1.12</u> <u>0.37-2.59</u>	<u>3/</u> <u>11</u> <u>6-16</u>	<u>3/</u> <u>2.38</u> <u>1.72-3.02</u>
Silty Mud	<u>2/</u> <u>11</u> <u>7-15</u>	<u>2/</u> <u>6.4</u> <u>6.2-6.5</u>	<u>2/</u> <u>0.78</u> <u>0.75-0.32</u>	<u>1/</u> <u>11</u>	<u>1/</u> <u>2.82</u>
Sandy Clay	<u>1/</u> <u>27</u>	<u>1/</u> <u>12.52</u>	<u>1/</u> <u>0.22</u>	-	-
Sandy Mud	<u>9/</u> <u>40</u> <u>16-77</u>	<u>9/</u> <u>7.1</u> <u>5.1-9.6</u>	<u>9/</u> <u>0.55</u> <u>0.16-1.44</u>	<u>3/</u> <u>8</u> <u>5-11</u>	<u>3/</u> <u>1.77</u> <u>1.76-1.78</u>
Clayey Sand	<u>3/</u> <u>82</u> <u>22-127</u>	<u>3/</u> <u>8.7</u> <u>4.0-12.6</u>	<u>3/</u> <u>0.14</u> <u>0.02-0.26</u>	-	-
Silty Sand	<u>3/</u> <u>131</u> <u>60-177</u>	<u>3/</u> <u>5.8</u> <u>4.9-7.0</u>	<u>3/</u> <u>1.05</u> <u>0.66-1.27</u>	-	-
Sand	<u>1/</u> <u>150</u> <u>-</u>	<u>1/</u> <u>2.02</u> <u>-</u>	<u>1/</u> <u>0.36</u> <u>-</u>	-	-

* Number of each type of analysis

TABLE II
CHARACTERISTICS OF ENGINEERING PROPERTIES
BY SEDIMENT TYPE

Sediment Type	Wet Unit Weight	Water Content	Shear Strength	Specific Gravity	Sensitivity	Porosity	Void Ratio
	Avg. Range g/cm ³	Avg. Range %	Avg. Range g/cm ²	Avg. Range	Avg. Range	Avg. Range %	Avg. Range
Silty Clay	* 6/ 1.13-1.22	9/ 265.3-440.5	7/ 0.3-13.3	3/ 2.39-2.50	5/ 2.46-2.50	5/ 1.6-3.3	5/ 37.5-39.3
Clayey Mud	1/ 1.23-1.37	12/ 198.3	12/ 1.4-41.5	12/ 2.49-2.60	11/ 2.54	11/ 3.3	11/ 82.2-83.9
Sandy Mud	5/ 1.26-1.36	5/ 123.3-136.2	5/ 9.8-35.9	5/ 2.53-2.60	5/ 1.9-6.4	5/ 3.6	5/ 79.5-82.2
Clayey Sand	4/ 1.33-1.46	4/ 88.2-141.1	4/ 14.1-35.2	4/ 2.61	4/ 4.6	4/ 2.9-7.5	4/ 70.5-78.2

* Number of each type of analysis

MCG 09005001

2.39-3.33

5.32-5.33

5.32-5.33

MGG 09005001

MGG 09005001

TABLE III
MASS PHYSICAL PROPERTIES

Core Length Water Depth cm m	Wet Unit Weight	Water Content	Shear Strength	Specific Gravity	Sensitivity	Porosity	Void Ratio	Median Diam. μ	Sorting	Skewness
Core 1 Site 2	* 4/ 154.5 8.8	1.26 T.15-T.3T	15/ 198.9 T36.0-363.7	15.3 2.8-26.0	2.53 2.46-2.60	2.5 2.1-3.1	4/ 84.2 80.3-89.5	4/ 5.70 4.08-8.53	8/ 12. 3-28	8/ 10.20 5.95-13.2T
	5/ 182.0 8.8	1.26 T.18-T.37	18/ 213.5 T22.3-440.5	19.9 0.8-40.1	2.50 2.42-2.56	2.8 2.0-3.7	5/ 83.4 76.0-88.8	5/ 5.41 3.16-7.95	10/ 8.7 3-40	10/ 8.70 5.45-13.49
Core 2 Site 2	8/ 221.0 8.8	1.23 T.13-T.36	21/ 219.8 T38.4-433.1	23.3 2.8-42.2	2.51 2.39-2.61	3.4 2.7-4.2	7/ 83.4 78.1-89.3	7/ 5.39 3.57-8.38	11/ 13. 3-37	11/ 8.70 4.40-11.3T
	6/ 193.0 8.8	1.32 T.23-T.39	19/ 180.7 T03.5-306.2	22.6 1.4-35.2	2.56 2.52-2.67	4.2 2.9-7.0	5/ 80.0 77.0-83.9	5/ 4.09 3.34-5.23	11/ 44. 7-150	11/ 7.06 2.02-15.3
Core 5 Site 1	3/ 196.0 8.8	1.31 T.24-T.4T	19/ 167.0 T02.6-222.4	34.7 28.1-43.6	2.58 2.56-2.59	4.2 3.3-5.6	3/ 81.6 77.2-84.9	3/ 4.60 3.39-5.62	0 0	0 0
	4/ 101.0 7.6	1.25 T.18-T.35	10/ 235.4 97.8-395.1	4/ 17.9 6.3-41.5	4/ 2.51 2.41-2.57	3/ 2.1 1.6-2.7	3/ 81.2 76.9-87.5	3/ 5.0 3.32-7.03	6/ 52. 2-177	6/ 7.25 5.49-9.60
Core 6 Site 3	3/ 187.0 11.9	1.40 T.35-T.49	20/ 127.47 83.9-248.8	27.0 12.0-47.1	2.63 2.61-2.67	3.7 1.5-5.2	3/ 74.6 69.6-78.5	3/ 3.08 2.29-3.65	0 0	0 0
	8/ 231.5 11.9	1.39 T.32-T.46	23/ 131.7 86.6-289.2	37.3 9.8-72.4	2.61 2.56-2.65	5.9 2.8-9.4	6/ 75.8 70.5-79.6	6/ 3.22 2.39-3.89	10/ 39. 7-93	10/ 5.82 4.03-11.04

* Number of each type of analysis

parameters among the sites is rather slight when considering the bay environment as a whole. An indication of the variation of the mass physical properties with depth at these sites is shown in Figures 3, 4, 5, and 6. Some of the interrelationships of these parameters to each other and to depth are evident in these figures. Detailed summary sheets for the mass physical properties studied in this report are presented in appendix B.

Clay content of the sediments averaged 40 percent with kaolinite, illite, and montmorillonite the predominant clay minerals in the order of decreasing abundance. The ratio of kaolinite to illite was found to be a significant variable affecting the strength of these sediments (Holmes and Goodell, in press). The association is positive in that higher ratios indicate greater strength. Trask and Close (1958) found in their laboratory studies that for clay-silt-sand mixtures at a given water content shear strength increases with increasing amounts of montmorillonite, illite, and kaolinite in that order. The latter resulted in the smallest increase in strength. Montmorillonite has a less significant role in the strength of the St. Andrew Bay sediments than was indicated by Trask due to its minor occurrence relative to kaolinite and illite.

Atterberg limits were determined on one core from each site. The plasticity index (liquid limit minus plastic limit) provides a quantitative measurement of the plastic characteristics of a remolded sediment sample by defining the range of water content in which the sediment is plastic. Based on these limits the bay sediments are classified as inorganic clays of high plasticity.

Sensitivity of the sediments (ratio of natural to remolded strength) ranges from 2 to 4 thus classifying them as medium sensitive. This range indicates that the amount of natural strength lost upon remolding is from 50 to 75 percent (Richards, 1961, p. 43).

Bearing capacities at various depths were calculated for sites 1 and 2 using equations (1) and (2). From these data and the bearing of each block, it was predicted that at site 2 the rectangular block should sink 44 cm. into the bottom, while the square and circular blocks should penetrate 49 and 33 cm. respectively. In actuality, the rectangular and circular blocks sank 61 cm., and the square block penetrated 93 cm. (Fig. 7). At site 1, it was again noted that the blocks penetrated further into the bottom than had been predicted. The blocks were left at site 1, and measurements 24 hours later indicated additional settlement varying from 5 to 7 cm. There is no correlation of the ratio of actual penetration to predicted penetration between the two sites. This may, however, be due to the lack of a sufficient quantity of data to statistically make a valid comparison.

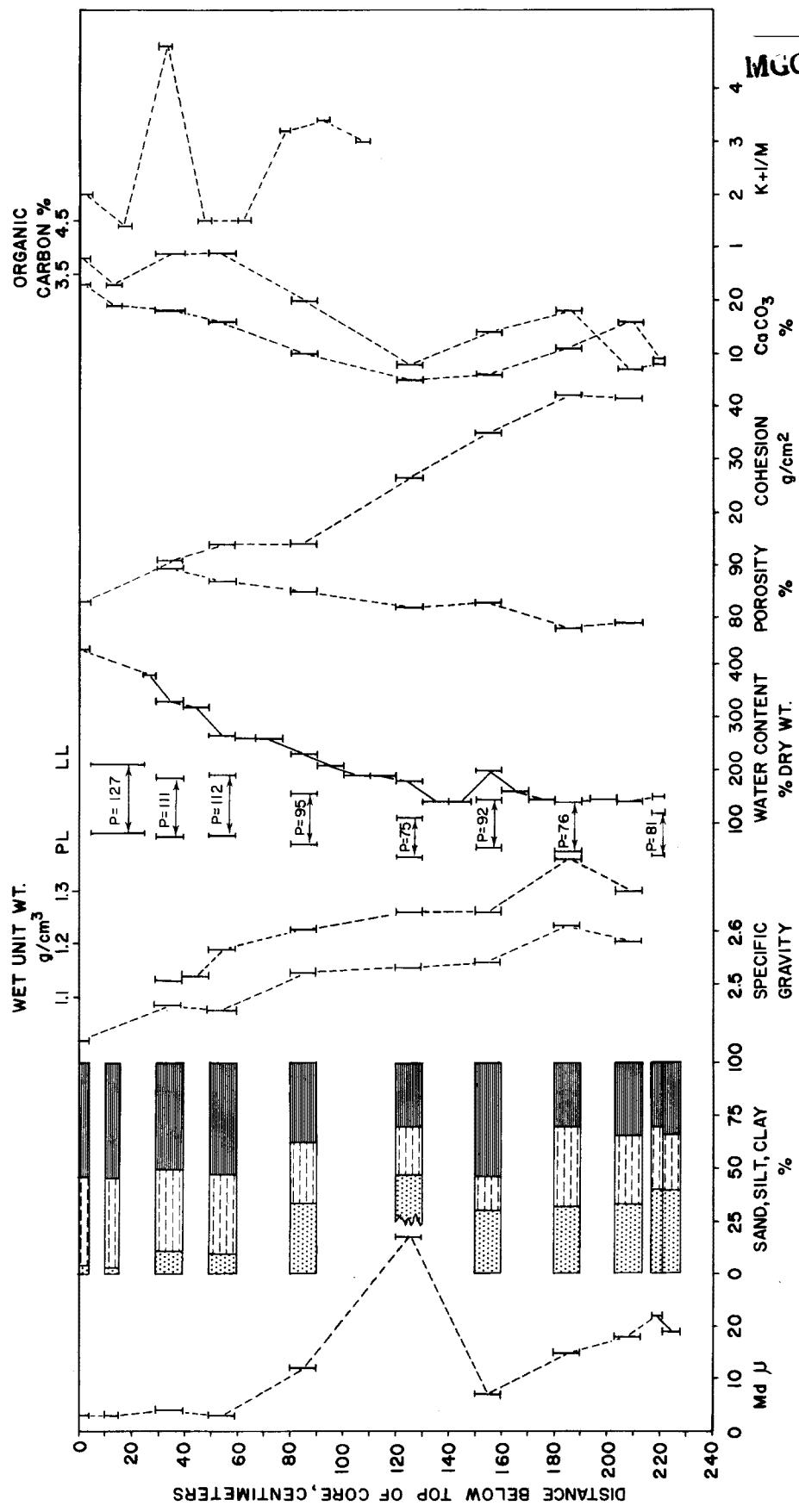


FIGURE 3 PARAMETERS VERSUS DEPTH FOR SITE 2, CORE 3

MGG 09005001

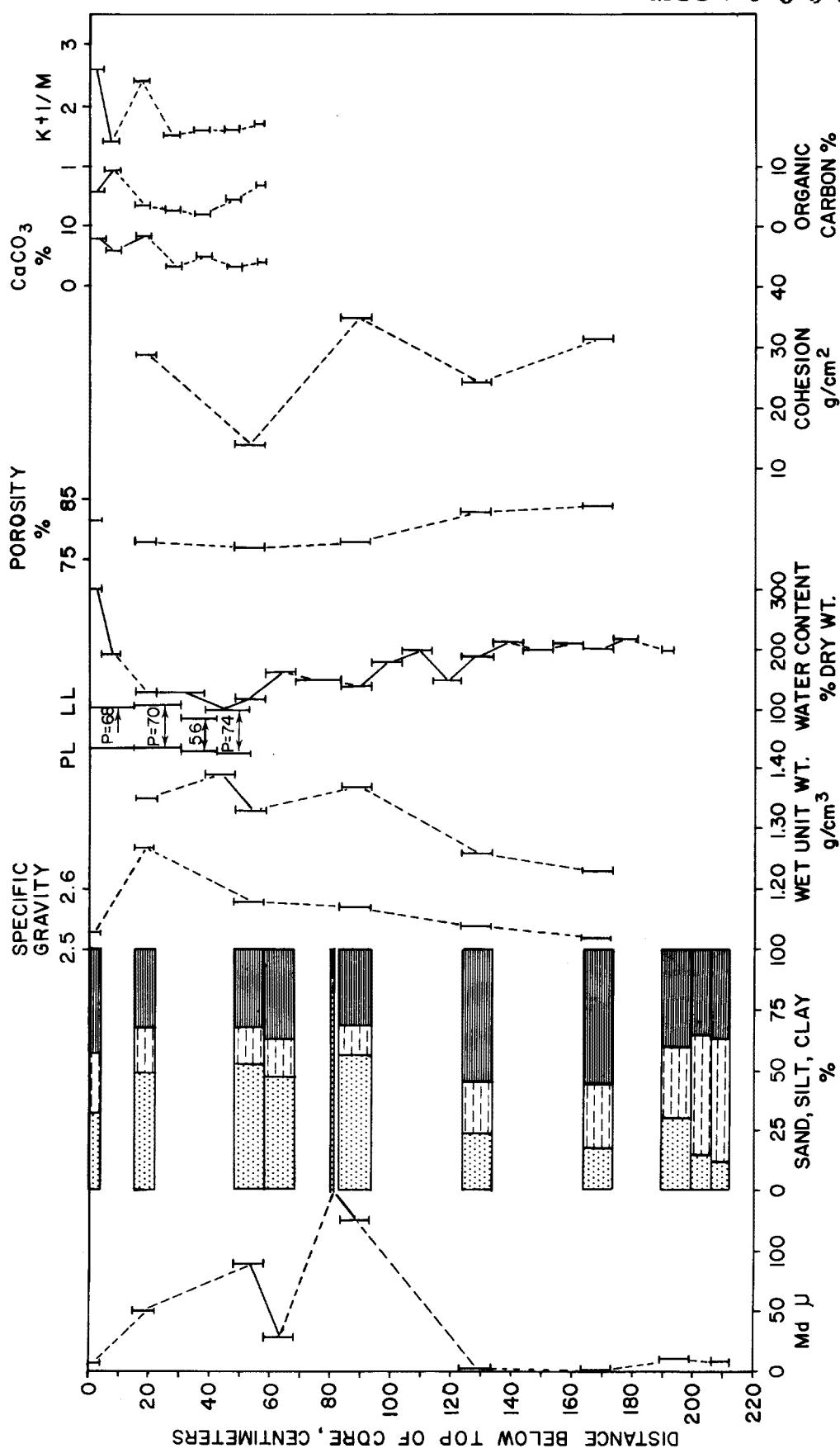


FIGURE 4 PARAMETERS VERSUS DEPTH FOR SITE I, CORE 4

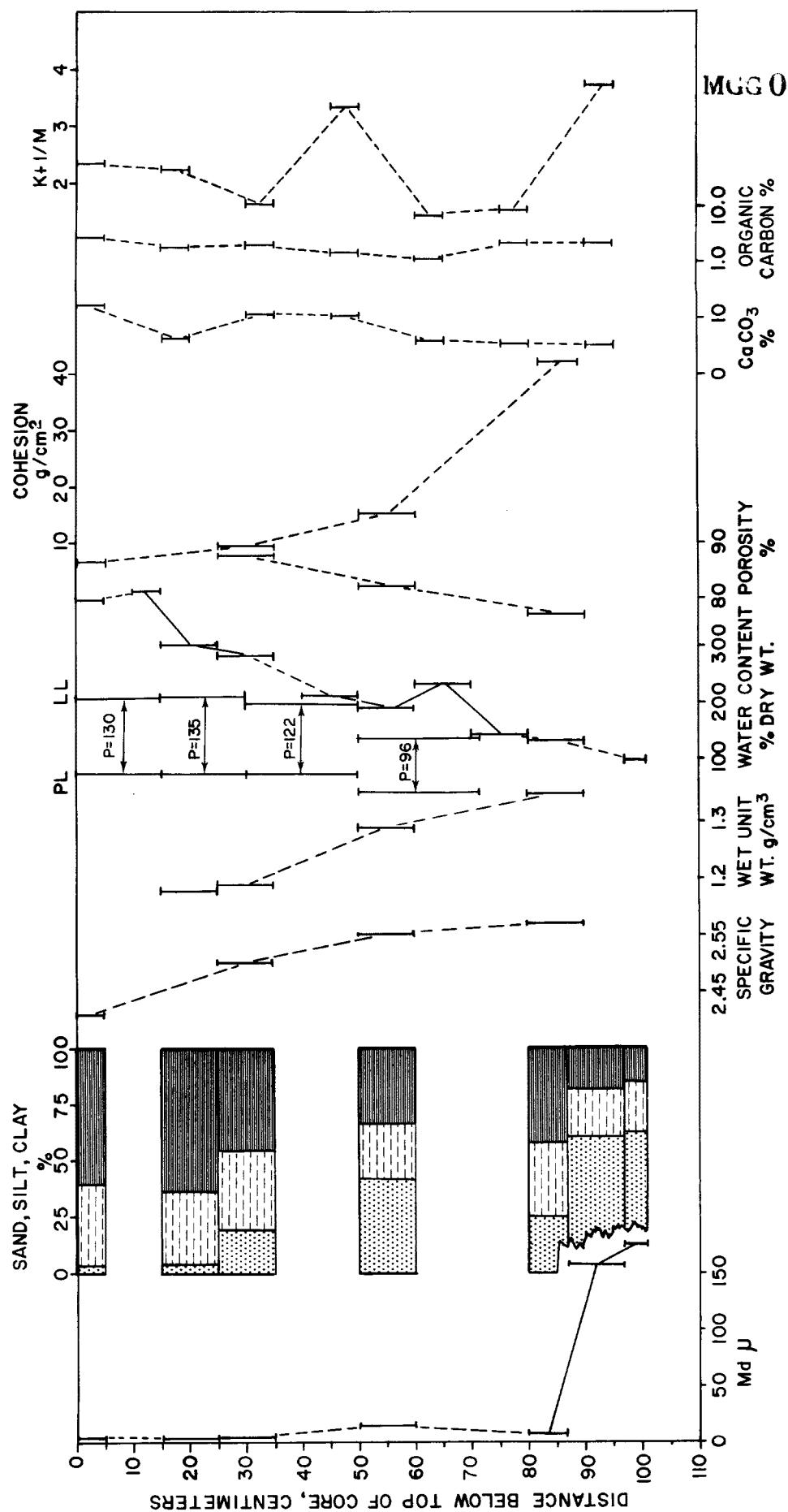


FIGURE 5 PARAMETERS VERSUS DEPTH FOR SITE 3, CORE 6

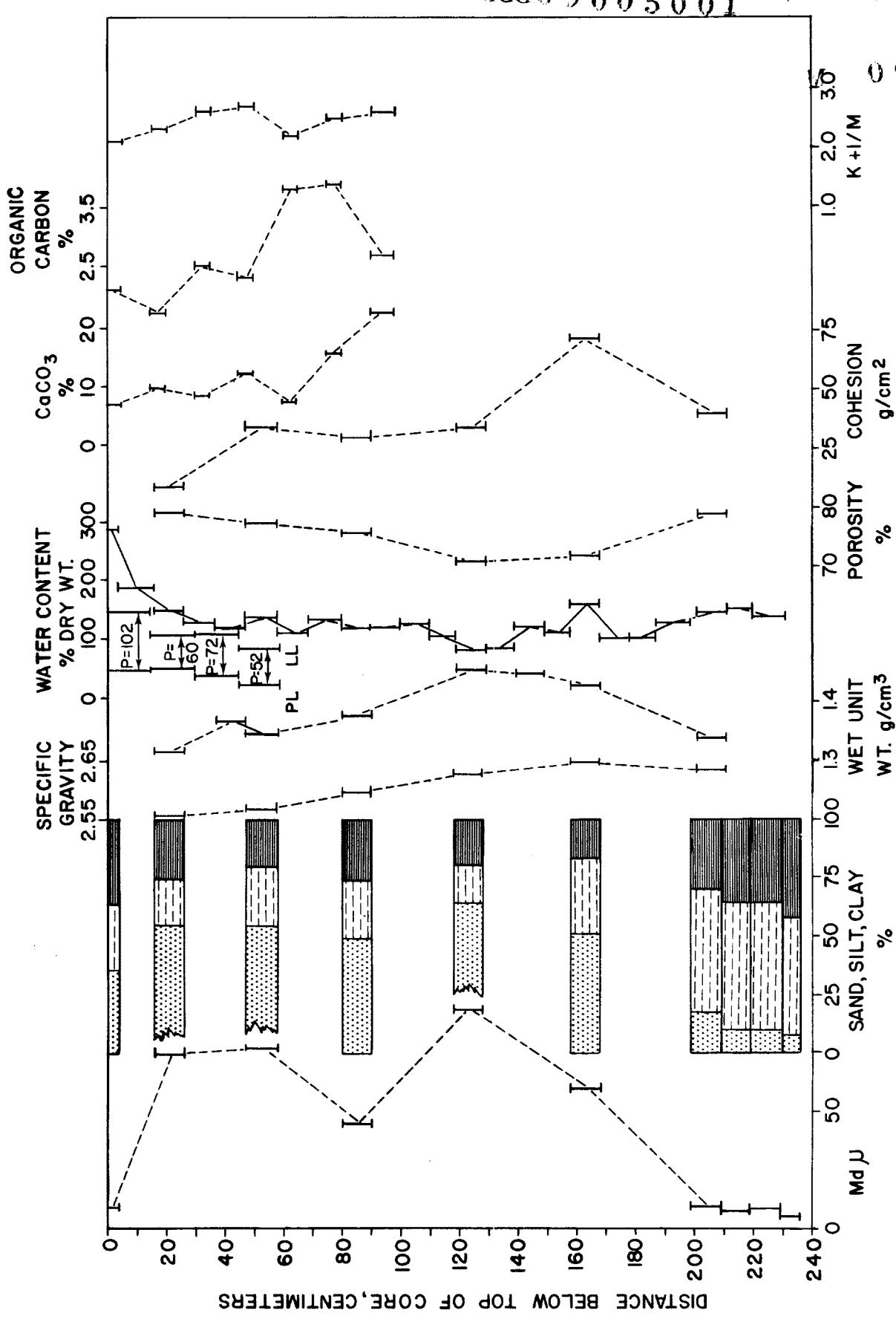
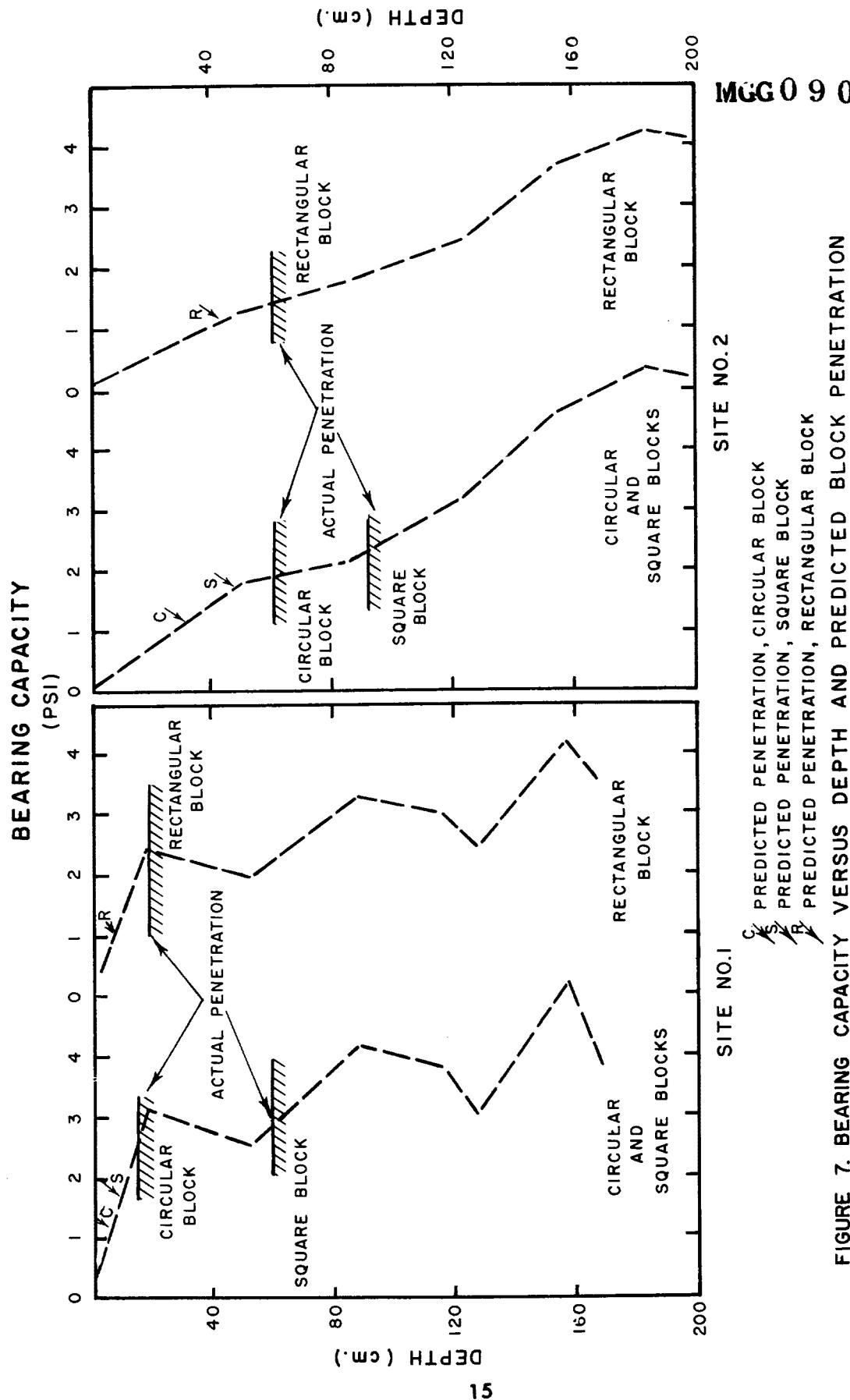


FIGURE 6 PARAMETERS VERSUS DEPTH FOR SITE 4, CORE 8



MGG 09005001

INTERPRETATIONS

It is generally agreed that coring techniques currently used by marine geologists result in disturbing the cored sediments to some degree. Some strength is lost owing to the crudeness of the tool and the rough handling the sample receives in shipment from the ship to the laboratory. On the other hand, a sample may gain strength as a result of compaction during sampling. It is obvious from the data presented here on core shortening that compaction has taken place in these samples. Whether the laboratory sample gives a higher or lower value than is found *in situ* cannot be determined until in-place measurements can be compared with those made on cored samples from the same site. Smith (1962) reports that shear strength values of gravity cores are usually higher by as much as a factor of two over piston core samples. Piston cores are, however, often disturbed as noted earlier and may not serve as a reliable reference.

Several relationships have been found among the various mass physical properties studies at St. Andrew Bay (Table IV). These observations indicate that the effect of each parameter on shear strength is also interdependent on the other sediment characteristics. The relationship of calcium carbonate and sorting to shear strength was found to be poor and only because of their interdependency with the other variables do they appear to have any effect on the strength values observed. Water content tends to influence shear strength more than any other measured parameter. Holmes and Goodell (in press) in their study of St. Andrew Bay found water content, depth in core, and the ratio of kaolinite to illite, in that order, the variables exerting the greatest influence on shear strength. The interdependence of these parameters, however, varied from each site to the extent that none of them serve as good predictors of strength.

It was anticipated that the blocks would not sink into the bottom as far as was predicted because the laboratory strength measurements were believed to be lower than the strength of the sediments in place. However, this was not the case; the blocks did penetrate further than predicted. Thus, the question arises as to what the shortened core sample represents in respect to the interval from which it was extracted. A second area of concern is whether the bearing capacity equations (1) and (2) are properly suited for use with rather weak, saturated sediments.

In regard to the core shortening problem, an attempt was made to apply the theories on core shortening, discussed earlier, to the cores from St. Andrew Bay. Three approaches were used: In the first, it was assumed that core shortening progressed continually as the barrel entered the bottom. The core was then stretched graphically to equal the interval penetrated using the water-sediment interface as the reference depth (Case II). The second approach was to assume that no core shortening occurred in the 0 to 50 cm. increment and that progressive shortening took place below this depth (Case III). The increment below 50 cm. was stretched graphically to equal the depth of penetration. A third approach was to assume that no core shortening took place (Case I).

MGG 0 9 0 0 5 0 0 1

TABLE IV

INTERRELATIONSHIPS OF SIGNIFICANT SEDIMENT CHARACTERISTICS BY RANK AND SEDIMENT
STRENGTH FOR ST. ANDREW BAY, FLORIDA (AFTER HOLMES AND GOODELL, 1962)

5 Larger % organic carbon	6 Less CaCO ₃ %	5 Less % organic carbon	4 Greater depths	3 More montmorillonite
4 Less CaCO ₃ %	5 Less kaolin	4 Less % clay content	3 Better sorting	2 Less CaCO ₃ %
3 Larger % clay content	4 Larger % clay content	3 Shallower depths	2 More CaCO ₃ %	1 Poorer sorting
2 Better sorting	2 Larger water content	1 Smaller mean grain sizes	1 Larger water content	
1 Smaller mean grain sizes				

MGG 09005001

Based on the three core shortening theories and equations (1) and (2), best fit curves were drawn showing the bearing capacities with depth for the various blocks at sites 1 and 2 (Figs. 8, 9, 10, and 11). At site 2, Case II provides a good correlation between the predicted and actual penetration of the blocks. In the case of the circular and square blocks, the predicted and actual depths of penetration were the same. Case II also provides the best correlation between the predicted and actual penetration of the rectangular block. The agreement of predicted versus actual penetration for the circular and square blocks at site 1 relative to site 2 and to the rectangular block at site 1 was poor. No apparent reason can be given for this poor correlation. Cases I and III showed poor correlation between the predicted and the actual penetration in all instances. Case II appears to provide the best interpretation of the bearing capacity data in the majority of instances.

It was also the purpose of this study to investigate whether it is necessary to modify the standard bearing capacity equations (1) and (2) for use with submarine sediments. The initial phases of this study indicated that the reliability of these equations for the prediction of object penetration into soft sediments was not too good. In an attempt to improve this reliability, a third equation was used to calculate a second series of bearing capacity values.

$$q = \pi c + \gamma d N_q \quad (4)$$

The value π was chosen because overstressing or progressive yielding begins in a zone when the unit load equals a bearing capacity of πc (Palmer 1953). This formula is commonly used in conjunction with rectangular footings (length greater than twice the width); however, Tschebotarioff (1951, p. 230) used a value of 3.33c for a circular footing when investigating the collapse of several farm silos. For this reason, the equation was used for all the blocks, regardless of their shape. Bearing capacities derived from this equation are also shown as best fit curves in Figures 8, 9, 10, and 11. In each case, the predicted penetration of the blocks using equation (4) was in excess of the actual penetration, while predictions based on equations (1) and (2) were always less than the observed penetration. Penetration factors, ratio of predicted penetration to actual penetration, were determined for the three cases of core shortening and the types of footing at the two sites. Table V shows the good agreement of penetration factors derived with equation (4). Penetration factor variations are generally ± 0.1 at each site and ± 0.25 between sites 1 and 2. Considerable variation is noted both at each site and between the two sites when the factors are related to equations (1) and (2). In some instances, however, the latter factors indicated perfect agreement between the predicted and the actual penetration.

Based on these observations it may be stated that the prediction of object penetration into the bottom of St. Andrew Bay might best be obtained from bearing capacities derived from equation (4). Considerably more information must be collected from this bay as well as other environments before any definite conclusions can be drawn from these initial postulations.

MGG 9005001

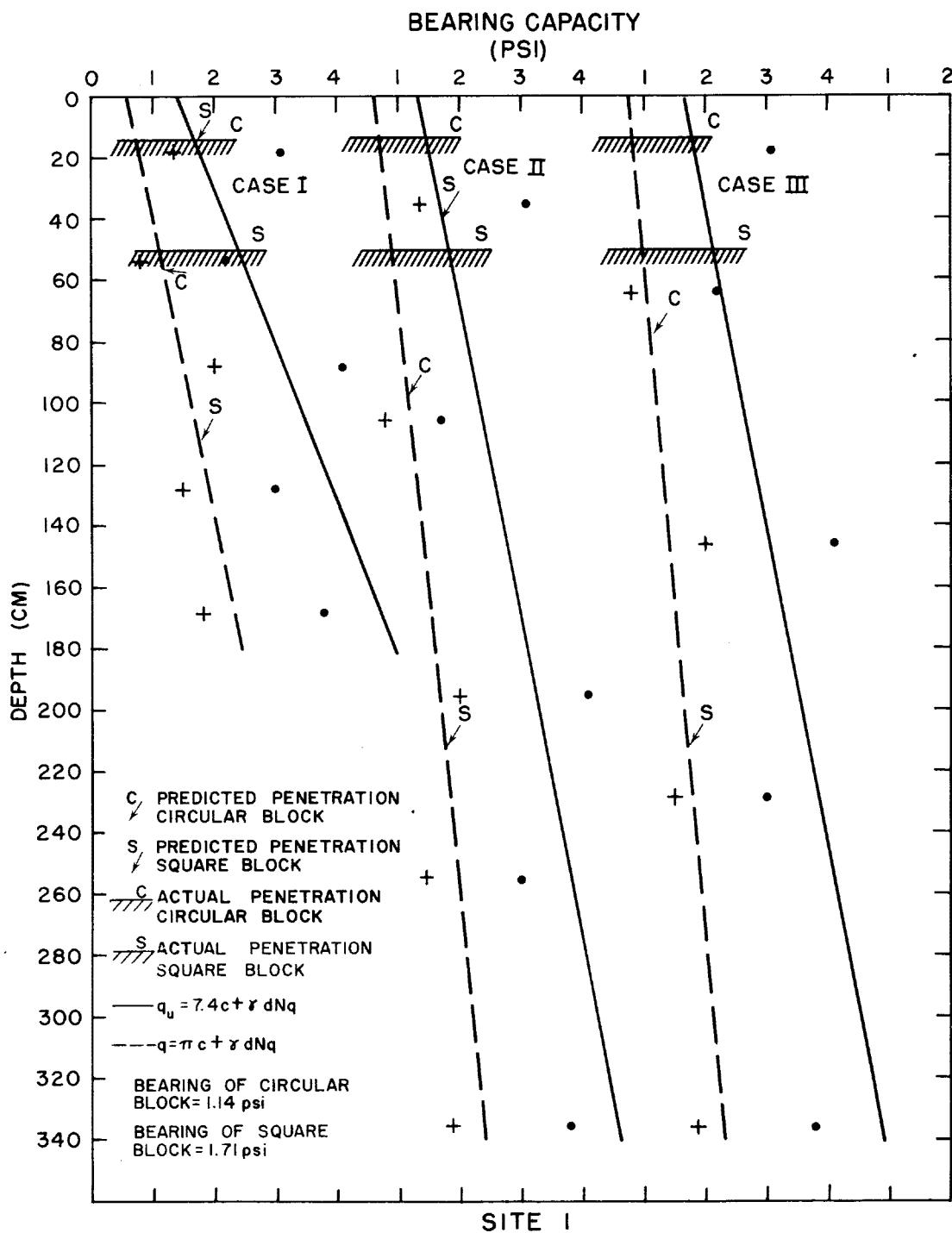


FIGURE 8. PREDICTED AND ACTUAL PENETRATION OF CIRCULAR AND SQUARE BLOCKS

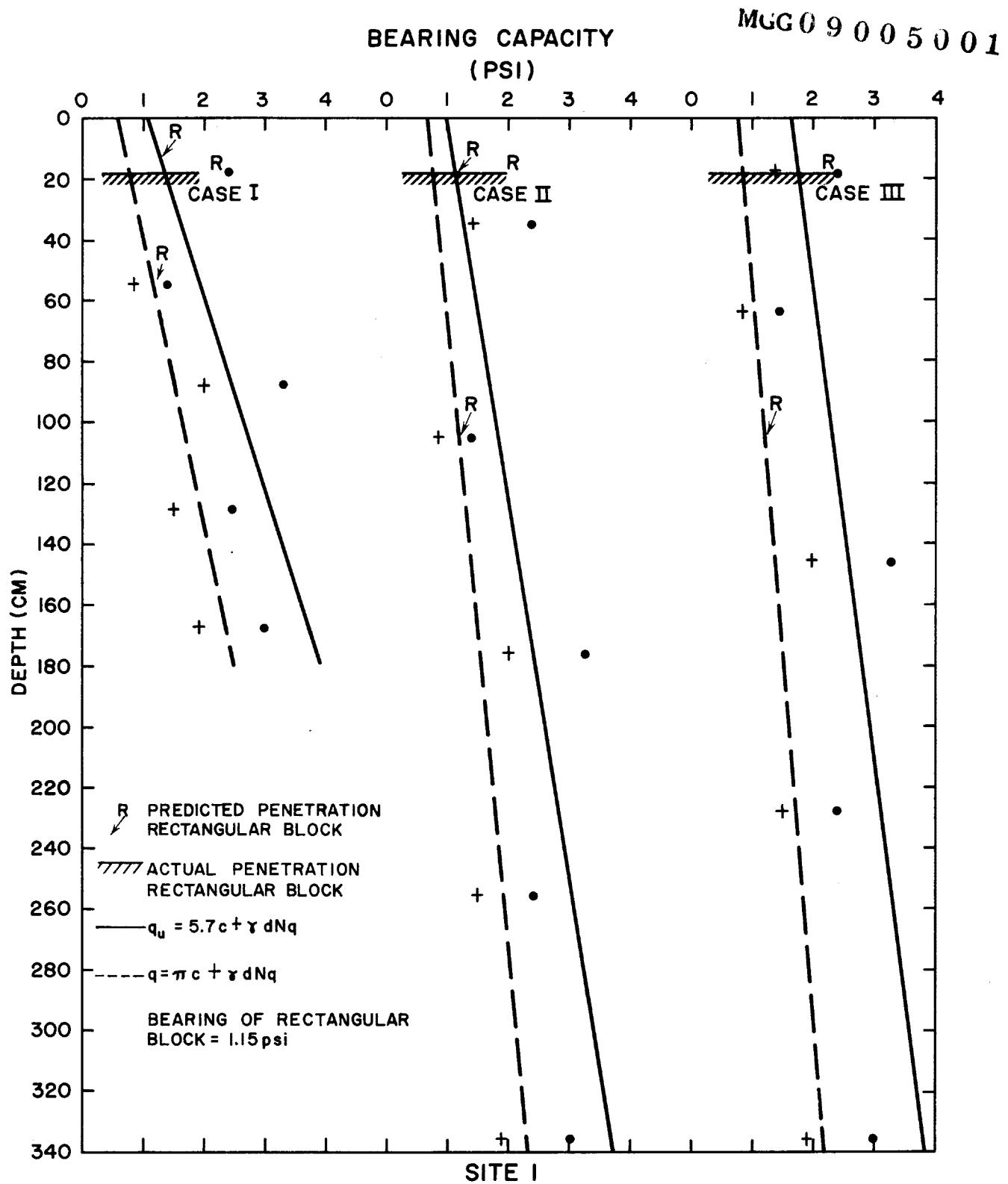


FIGURE 9 PREDICTED AND ACTUAL PENETRATION OF RECTANGULAR BLOCK

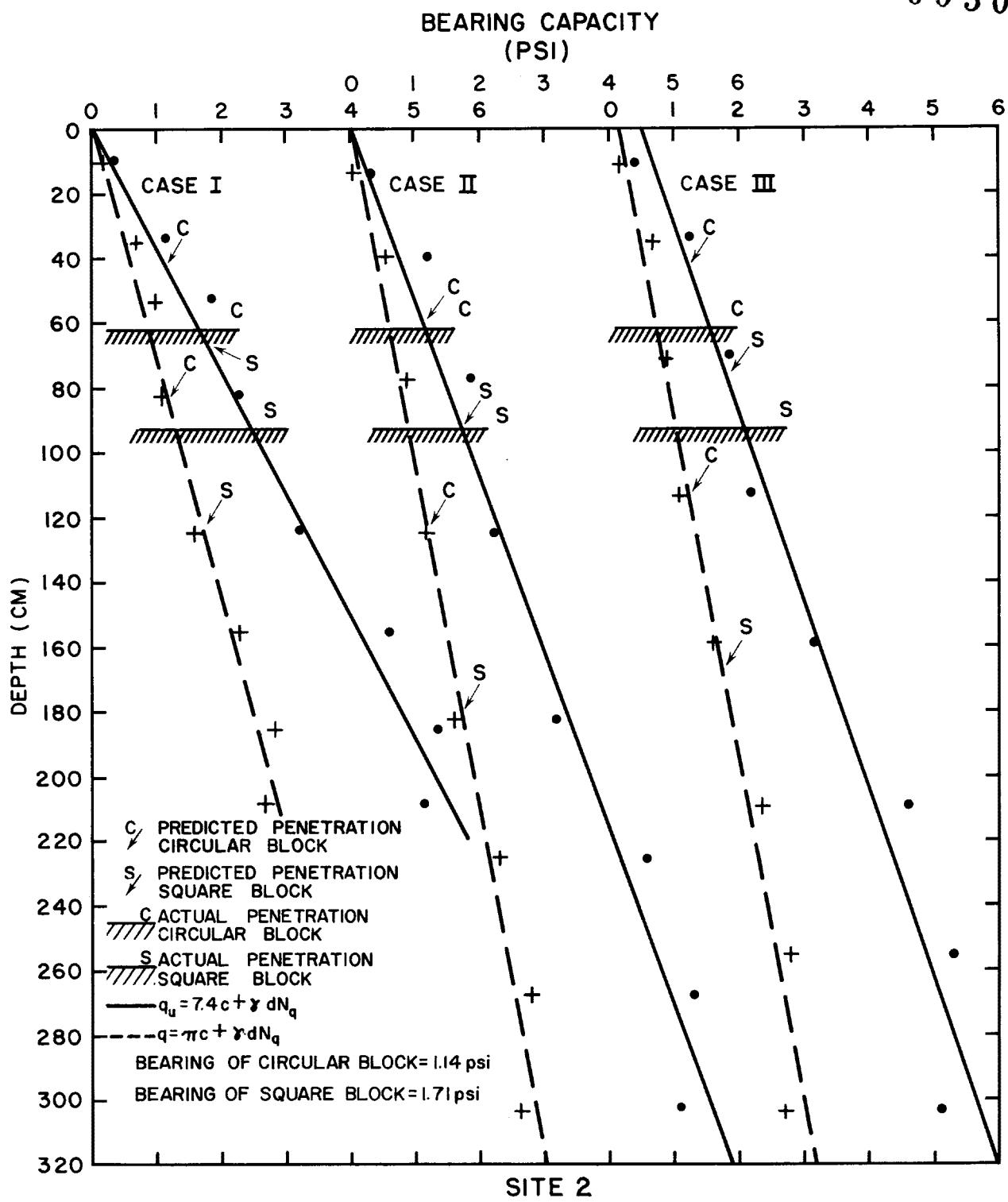


FIGURE 10. PREDICTED AND ACTUAL PENETRATION OF CIRCULAR AND SQUARE BLOCKS

McG 09005001

BEARING CAPACITY
(PSI)

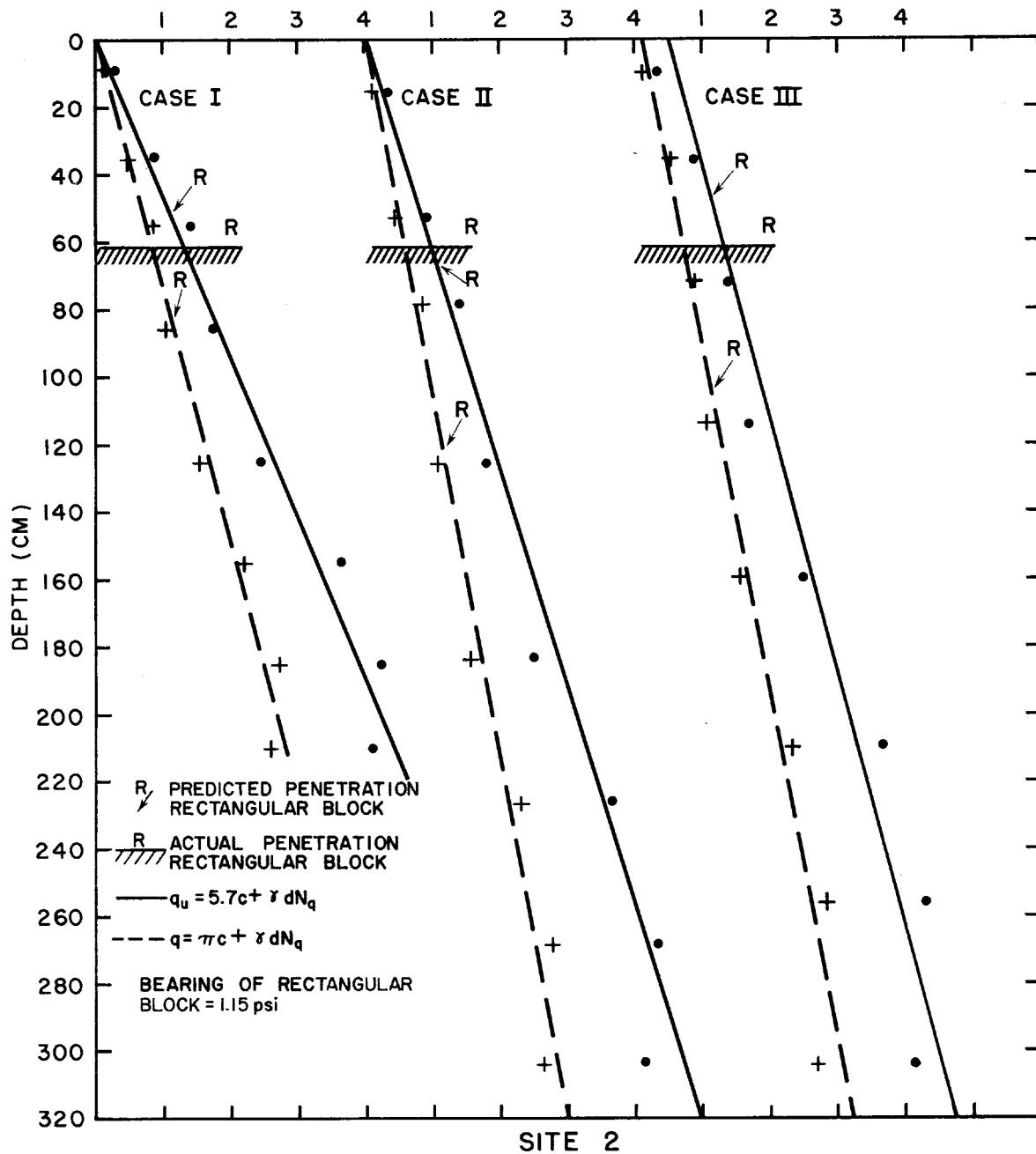


FIGURE II. PREDICTED AND ACTUAL PENETRATION OF RECTANGULAR BLOCK

TABLE V
PENETRATION FACTORS

Type of Block	SITE 1						SITE 2					
	Case I		Case II		Case III		Case I		Case II		Case III	
	A	B	A	B	A	B	A	B	A	B	A	B
Rectangular	0.4	9.0	0.2	1.0	0.2	15.0	0.7	1.2	0.5	0.8	0.6	1.2
Circular	0.3	1.4	0.2	15.0	0.2	15.0	0.7	1.5	0.5	1.0	0.6	1.5
Square	0.5	2.8	0.2	1.5	0.2	4.2	0.7	1.5	0.5	1.0	0.6	1.3

A - Based on equation (4)

B - Based on equations (1) and (2)

CONCLUSIONS

This investigation has pointed out two of the problem areas in the study of submarine soil mechanics: sampling techniques and bearing capacity formulae. Core shortening commonly occurs in gravity coring (without a piston), and the cored sample must be lengthened (scale expanded) to be correlated with the interval the sampler penetrated. This study indicates that penetration predictions based on core shortening throughout the entire length of the core (Case II) may be more reliable than those based on partial (Case III) or no core shortening (Case I).

Although the use of standard bearing capacity equations (1) and (2) resulted in the accurate prediction of object penetration in a few instances, they also led to rather poor predictions in other cases. It appears that the formula for progressive yielding (equation 4) may be more reliable for predicting depth of penetration in conjunction with lengthening the cored increment to equal the interval penetrated by the sampler. Additional effort should be expended to expand this present investigation to other areas of St. Andrew Bay as well as to several other environments, particularly the deep sea, in order to verify the assumptions presented here. Other types of in situ studies and measurements of the various engineering properties are also necessary to adequately study such problems as core shortening, sampler disturbance, the effect of removing the sample from its surrounding pressures, and the bearing capacity formulae to be used with weak submarine sediments.

MCC 09005001

This investigation was made possible by funds under TR/A Number 620-006.

The writer takes this opportunity to thank Mr. N. T. Stiles for his assistance throughout the study both in the field and the laboratory. I am indebted to Mr. W. Tolbert and Mr. G. Salsman of the Navy Mine Defense Laboratory for making the underwater observations. I am pleased to acknowledge the cooperation of Mr. P. P. Brown, Navy Bureau of Yards and Docks, and Mr. C. M. Yeomans, National Bureau of Standards for their guidance and interest in this work. Helpful comments and suggestions during various phases of this study were made by Dr. E. L. Hamilton of the Navy Electronic Laboratory, and Dr. R. Smith of the Navy Civil Engineering Laboratory.

09005001

REFERENCES

- Allison, L. E. (1935) Organic soil carbon by reduction of chromic acid. Soil Science, vol. 40, p. 311.
- Cadling, L., and Odenstad, S. (1950) The vane borer, an apparatus for determining the shear strength of clay soils directly in the ground. Royal Swedish Geotechnical Institute Proceedings, no. 2, 88 p.
- Emery, K. O., and Dietz, R. S. (1941) Gravity coring instrument and mechanics of sediment coring. Geological Society of America Bulletin, vol. 52, p. 1635-1714.
- Fisk, H. N., and McClelland, B. (1959) Geology of continental shelf off Louisiana: its influence on offshore foundation design. Geological Society of America Bulletin, vol. 70, p. 1369-1394.
- Hamilton, E. L. (1950) Thickness and consolidation of deep-sea sediments. Geological Society of America Bulletin, vol. 70, p. 1399-1424.
- (1960) Ocean basin ages and amounts of original sediments. Journal of Sedimentary Petrology, vol. 30, p. 370-379.
- Holmes, C. W., and Goodell, H. G. (1962) Cohesion in bay sediments. Unpublished Manuscript, Sedimentological Research Laboratory, Department of Geology, Florida State University, Tallahassee, Florida, 49 p.
- , ----- (In press) The prediction of strength in sediments of St. Andrew Bay, Florida. Journal of Sedimentary Petrology.
- Hvorslev, M. J. (1949) Subsurface exploration and sampling of soils for civil engineering purposes. Vicksburg, Mississippi, U. S. Army Corps of Engineers, Waterways Experiment Station, 521 p.
- Ichiye, T., and Jones, M. L. (1961) On the hydrography of the St. Andrew Bay system, Florida. Limnology and Oceanography, vol. 6, no. 3, p. 302-311.
- Kallstenius, T. (1958) Mechanical disturbances in clay samples taken with piston samplers. Royal Swedish Geotechnical Institute Proceedings, no. 16, 75 p.
- Krumbein, W. C., and Pettijohn, F. J. (1938) Manual of Sedimentary Petrography. Appleton-Century-Crofts, New York, 549 p.
- McClelland, B. (1956) Engineering properties of soils on the continental shelf of the Gulf of Mexico. Eighth Texas Conference on Soil Mechanics and Foundation Engineering Proceedings, 28 p.

MGG 09005001

- Moore, D. G. (1959) Stability of deep-sea sedimentary slopes, p. 474-476 in International Oceanographic Congress preprints. Washington, American Association for the Advancement of Science, 1022 p.
- Palmer, L. A. (1953) Soil mechanics and earth structures. U. S. Navy Bureau of Yards and Docks, Technical Publication PW-18, 144 p.
- Richards, A. F. (1961) Investigations of deep-sea sediment cores, I. shear strength, bearing capacity and consolidation. U. S. Navy Hydrographic Office Technical Report no. 63, 70 p.
- (1962) Investigations of deep-sea sediment cores, II. mass physical properties, U. S. Navy Hydrographic Office Technical Report no. 106, 146 p.
- , and Keller, G. H. (1961) A plastic-barrel sediment corer. Deep-Sea Research, vol. 8, p. 306-312.
- Shepard, F. P. (1954) Nomenclature of sand-silt-clay ratios. Journal of Sedimentary Petrology, vol. 24, p. 151-158.
- Smith, R. J. (1962) Deep ocean boring and soil testing investigations. U. S. Naval Civil Engineering Laboratory, TN-445.
- Taylor, D. W. (1943) Fundamentals of Soil Mechanics. New York, Wiley, 700 p.
- Trask, P. D., and Rolston, J. W. (1950) Relation of strength of sediments to water content and grain size. Science, vol. 111, p. 666-667.
- , and Close, J. E. H. (1958) Effect of clay content on strength of soils. Sixth conference on coastal engineering, Proceedings, vol. 6, p. 827-843.
- Tschebotarioff, G. P. (1951) Soil mechanics, foundations, and earth structures. New York, McGraw-Hill, 655 p.
- Turekian, K. K. (1956) Rapid technique for determination of carbonate content of deep-sea cores. American Association of Petroleum Geologists Bulletin, vol. 40, p. 2507-2509.
- U. S. Navy Hydrographic Office (1955) Instruction manual for oceanographic observations. 2nd ed., Hydrographic Office Publication no. 607, Washington, 210 p.
- Waller, R. A. (1961) Ostracods of the St. Andrew Bay System. M. S. thesis, Dept. of Biol. Sciences, Florida State University, Tallahassee, Florida, 46 p.

MGG 09005001

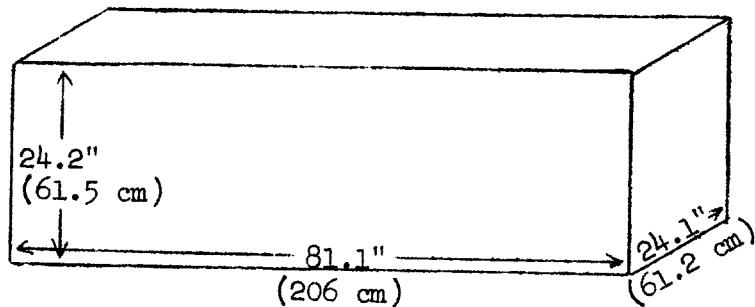
APPENDIX A

DIMENSIONS AND WEIGHTS OF THE CEMENT BLOCKS

DIMENSIONS AND WEIGHTS OF THE CEMENT BLOCKS

MGG 09005001

RECTANGULAR BLOCK

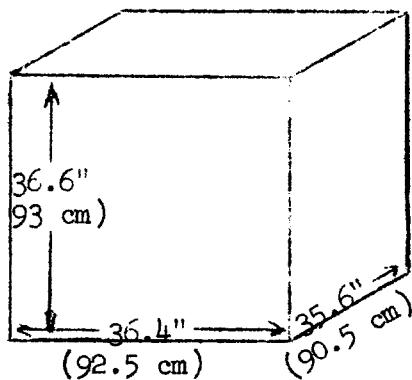


Weight in air: 3970 lbs

Weight in water: 2219 lbs

Bearing weight in water:
1.14 psi

SQUARE BLOCK

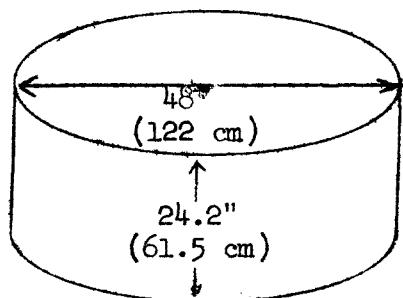


Weight in air: 3970 lbs

Weight in water: 2213 lbs

Bearing weight in water:
1.71 psi

CIRCULAR BLOCK



Weight in air: 3700 lbs

Weight in water: 2078 lbs

Bearing weight in water:
1.15 psi

MGG 09005001

APPENDIX B

**SUMMARY SHEETS OF MASS PHYSICAL
PROPERTIES OF BOTTOM SEDIMENTS
AND EXPLANATION OF DATA PAGES**

EXPLANATION OF DATA PAGES 14-109005001
CORE ANALYSIS SUMMARY SHEET
Engineering Properties
NAVOCEANO (EXP) 3167/18B (Rev. 1-63)

Results of, engineering properties, core analysis performed by the U. S. Naval Oceanographic Office Geological Laboratory are recorded on Core Analysis summary Sheet Engineering Properties.

The following is a description of the terms employed on the Core Analysis Summary Sheet:

1. Cruise Number. A number assigned to each cruise for identification purposes.
2. Latitude. Expressed in degrees, minutes, and seconds.
3. Longitude. Expressed in degrees, minutes, and seconds.
4. Sample Number. A consecutive number, commencing with 1, applied to each core taken successively throughout the cruise.
5. Date Taken. Day (GMT), month, and year.
6. Water Depth (m). The uncorrected sonic sounding recorded in meters.
7. Type Corer. Identified by the name of device employed.
8. Core Length (cm). Recorded in centimeters as observed in the laboratory.
9. Core Penetration (cm). Recorded in centimeters as observed in the field.
10. Subsample Depth in Core (cm). Interval of subsample as measured in centimeters from the top of the core.
11. Wet Unit Weight (g/cm^3). The weight (solids plus water) per unit volume of the sediment mass.
12. Specific Gravity of Solids. The ratio of weight in air of a given volume of a sediment at 20°C to the weight in air of an equal volume of distilled water at 20°C.

MGG 09005001

13. Water Content (% dry weight). The ratio, in percent, of the weight of water in a given mass of the sediment sample to the weight of the solid particles.

14. Void Ratio. The ratio of the volume of void spaces to the volume of solid particles in the sediment sample as computed from Wet Unit Weight, Specific Gravity of Solids, and Water Content.

15. Saturated Void Ratio. The Void Ratio at 100 percent saturation as computed from Water Content and Specific Gravity of Solids.

$$\text{Saturated Void Ratio} = \frac{\text{Water Content} \times \text{Specific Gravity of Solids}}{100}$$

16. Porosity (%). The ratio, usually expressed as a percentage, of the volume of voids of a sediment mass to the total volume of the sediment mass.

17. Liquid Limit. Water Content, in percent, at which a pat of sediment cut by a groove of standard dimension will flow together for a distance of 1/2 inch under the impact of 25 blows in a standard liquid limit apparatus.

18. Plastic Limit. Water Content, in percent, at which a sediment will just begin to crumble when rolled into a thread approximately 1/8 inch in diameter.

19. Plasticity Index. The numerical difference between the Liquid Limit and Plastic Limit of the sediment mass.

20. Liquidity Index. The ratio, expressed in percentage, of (1) the natural water content of the sediment sample minus its Plastic Limit to (2) its Plasticity Index.

21. Compression Index. The slope of the linear portion of the Pressure-Void Ratio curve on a semi-log plot.

22. Compressive Strength. The load per unit area required to shear an unconfined, natural or remolded, sediment mass.

23. Cohesion. The shearing strength per unit area under zero externally applied load.

24. Sensitivity. The ratio of the natural to the remolded strength. It is a measure of the loss of strength due to remolding the sediment mass.

25. Angle of Internal Friction ($^{\circ}$). The angle between the abscissa and the

MGG 0 9 0 0 5 0 0 1

tangent of the curve representing the relationship of "shearing resistance" to "normal stress" acting within a sediment mass.

26. Activity. The ratio of the Plasticity Index to the clay fraction percentage ($< .002$ mm) of the sediment mass.

27. Modulus of Elasticity. The ratio of stress to strain of the sediment mass.

28. Slump (%). The ratio, in percent, of the amount of height change immediately before the compressive strength test to the original height of a cylinder of sediment.

MGG 0 9 0 0 5 0 0 1

EXPLANATION OF DATA PAGES
CORE ANALYSIS SUMMARY SHEET
Sediment Size and Composition
NAVOCEANO (EXP) 3167/18A (Rev. 1-63)

Results of, sediment-size and -composition, core analysis performed by the U. S. Naval Oceanographic Office Geological Laboratory are recorded on Core Analysis Summary Sheet Sediment Size and Composition.

The following is a description of the terms employed on the Core Analysis Summary Sheet:

1. Cruise Number. A number assigned to each cruise for identification purposes.
2. Latitude. Expressed in degrees, minutes, and seconds.
3. Longitude. Expressed in degrees, minutes, and seconds.
4. Sample Number. A consecutive number, commencing with 1, applied to each core taken successively throughout the cruise.
5. Date Taken. Day (GMT), month, and year.
6. Water Depth (m). The uncorrected sonic sounding recorded in meters.
7. Type Corer. Identified by name of device employed.
8. Core Length (cm). Recorded in centimeters as observed in the laboratory.
9. Core Penetration (cm). Recorded in centimeters as observed in the field.
10. Laboratory Number. A reference number assigned to a fraction of a sample retained by the laboratory.
11. Subsample Depth in Core (cm). Interval of subsample as measured in centimeters from the top of the core.
12. Color (GSA Rock Color Chart). Based on the Geological Society of America Rock-Color Chart. F or L indicates where color determination was made. For those samples where color was determined in the laboratory, the sample was moistened for a color determination.
13. Odor. A qualitative description of any noticeable odors.

14. Size and Composition Analysis.

MGG 9005001

a. through n. Sample fraction diameter size values are based on dry weight and are given in millimeters to the nearest whole percent. An American Instrument Company sieving machine and U. S. standard sieves were used for determining sand and larger fractions ($> .062\text{mm}$). The pipette method, based on Stokes' Law (for computing settling rates of spherical particles), was used to determine silt size (.062 to .004 mm) and clay size particles ($< .004\text{ mm}$).

o. Median Diameter (mm). Is the middle most member of the distribution curve above which 50 percent of the diameters in the distribution are larger and below which 50 percent of the diameters are smaller expressed in millimeters.

p. Sorting Coefficient. Is the square root of the ratio of the two quartiles, so chosen that the value is always greater than unity. (Trask 1932).

$$\text{Sorting Coefficient} = \sqrt{\frac{Q_{25}}{Q_{75}}}$$

q. Skewness. Is a measurement of the asymmetry of the curve in such a way that departure of the mean from the median is independent of the spread or deviation of the curve. Expressed in millimeters to the nearest hundredth with the given value computed from Trask's formula.

$$\text{Skewness} = \frac{Q_{25} - Q_{75}}{\text{Median Diameter}^2}$$

r. Standard Deviation (mm). A measure, in millimeters, of the degree of spread or degree of dispersion of the data about the central tendency.

$$\text{Standard Deviation} = \sqrt{\sum_{i=1}^n (X_i - \bar{X})^2 / (n-1)}$$

s. Sediment Type. Determined by sand, silt, and clay ratios of the sample based on the F. P. Shepard sediment triangle (as modified) shown in Figure B-1.

t. and u. Dominant and Secondary Minerals (%). Percentage of fraction volume of the dominant and secondary minerals.

MGG U 9 0 0 5 0 0 1

v. Calcium Carbonate (%). Percentage of total sample weight determined by EDTA method.

w. Organic Carbon (%). Percentage of total sample weight determined by Allison method.

15. Remarks.

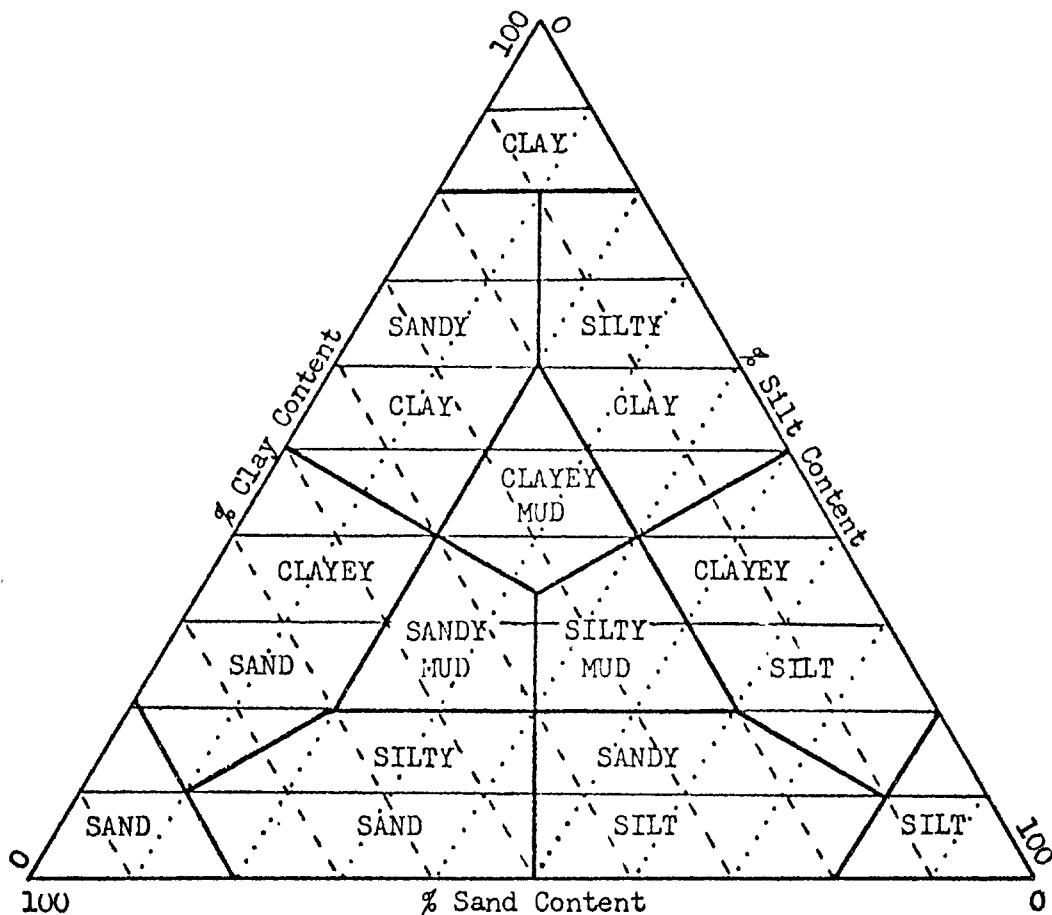


FIGURE B-1. MODIFIED NOMENCLATURE OF SEDIMENT TYPES
(after Shepard, 1954, p. 157)

CORE ANALYSIS SUMMARY SHEET
ENGINEERING PROPERTIES

117-05

NAVOCANO-EXP-3167/18-8 (Rev. 1-63)

ANALYZED BY Keller & Stiles

DATE 10 April 1963

1. CRUISE NO. <u>SUBSOME</u>	4. SAMPLE NO. <u>BS-1</u>	7. TYPE CORER <u>Hydroplastic</u>
2. LATITUDE <u>30° 0' N</u>	5. DATE TAKEN (Date, month, year) <u>9 April 1963</u>	8. CORE LENGTH (cm) <u>154.5</u>
3. LONGITUDE <u>85° 0' W</u>	6. WATER DEPTH (m) <u>8.8</u>	9. CORER PENETRATION (cm) <u>370.0</u>
10. SUBSAMPLE DEPTH IN CORE (cm)	0-10	10-20
11. WET UNIT WEIGHT (g/cm ³)	1.15	1.15
12. SPECIFIC GRAVITY OF SOLIDS	2.46	2.52
13. WATER CONTENT (% dry weight)	363.7	334.8
14. VOID RATIO	8.53	8.43
15. SATURATED VOID RATIO	8.43	8.43
16. POROSITY (%)	89.5	83.6
17. LIQUID LIMIT	206	
18. PLASTIC LIMIT		
19. PLASTICITY INDEX		
20. LIQUIDITY INDEX		
21. COMPRESSION INDEX FROM LL		
22. COMPRESSIVE STRENGTH NATURAL (g/cm ²) REMOULD (g/cm ²)		
23. COHESION NATURAL (g/cm ²) REMOULD (g/cm ²)	2.8	17.6 5.6
24. SENSITIVITY		3.1 2.1
25. ANGLE OF INTERNAL FRICTION (°)		
26. ACTIVITY		
27. MODULUS OF ELASTICITY		
28. SLUMP (in)		
29. REMARKS <u>Gravity Core, 150 lbs. plus release March.</u> <u>Site #2</u>		

CORE ANALYSIS SUMMARY SHEET
ENGINEERING PROPERTIES

0464
MCGO 9005001
ANALYZED BY Keller + Stiles
DATE 10 April 1963

NAVOCEANO-EXP-3167/18-8 (Rev. 1-63)

1. CRUISE NO.	SUBSOME	4. SAMPLE NO.	BS-1	7. TYPE CORER	Hydroplastic	
2. LATITUDE	30° 10'	10. N	5. DATE TAKEN (day, month, year)	9 April 1963	6. CORE LENGTH (cm)	154.5
3. LONGITUDE	85° 42' F/W	"	6. WATER DEPTH (m)	8.8	9. CORER PENETRATION (cm)	370
10. SUBSAMPLE DEPTH IN CORE (cm)	120.5	137.5 - 148.5	131.5 - 154.5			
11. WET UNIT WEIGHT (g/cm³)	1.31					
12. SPECIFIC GRAVITY OF SOLIDS	2.60					
13. WATER CONTENT (% dry weight)	162.1	147.6	145.6			
14. VOID RATIO	4.08					
15. SATURATED VOID RATIO	4.26					
16. POROSITY (%)	80.3					
17. LIQUID LIMIT						
18. PLASTIC LIMIT						
19. PLASTICITY INDEX						
20. LIQUIDITY INDEX						
21. COMPRESSION INDEX FROM LL						
22. COMPRESSIVE STRENGTH NATURAL	(g/cm²)					
	REMOULD	(g/cm²)				
23. COHESION	NATURAL (g/cm²)	26.0				
	REMOULD (g/cm²)	11.2				
24. SENSITIVITY		2.3				
25. ANGLE OF INTERNAL FRICTION (°)						
26. ACTIVITY						
27. MODULUS OF ELASTICITY						
28. SLUMP (in)						
29. REMARKS						

CORE ANALYSIS SUMMARY SHEET
SEDIMENT SIZE AND COMPOSITION

MCGO 9005001

ANALYZED BY STEWART & LLOYD

NOVOCHEAO-ER-31671B-A (Rev. 1-63)

1. CRUISE NO.	SUBSOME	4. SAMPLE NO.	BS-1	7. TYPE CORER PVC - Hydroplastic					
2. LATITUDE	30° 10' N	5. DATE TAKEN (DAY, MO., YR.)	9 April / 63	8. CORE LENGTH (cm)	154.5				
3. LONGITUDE	85° 42' W	6. WATER DEPTH (m)	8.8	9. CORE PENETRATION (cm)	370.				
10. LABORATORY NUMBER	187-1	187-2	187-3	187-4	187-5	187-6	187-7	187-29	
11. SUBSAMPLE DEPTH IN CORE (cm)	0-10	25-35	46-56	70-80	80-90	100-115	146-154.5		
12. COLOR (GSA ROCK COLOR CHART) FIELD <input checked="" type="checkbox"/> LAB DETERMINATION	SY2/1	SY2/1	SY2/1	SY2/1	SY2/1	SY2/1	SY2/1	SY2/1	
13. ODOR	H ₂ S	H ₂ S	H ₂ S	H ₂ S	H ₂ S	H ₂ S	H ₂ S	H ₂ S	
14. SIZE & COMPOSITION ANALYSIS									
a.	→ 4 mm (%)								
b.	4 to 2 mm (%)								
c.	2 to 1 mm (%)								
d.	1 to .500 mm (%)								
e.	.500 to .250 mm (%)								
f.	.250 to .125 mm (%)								
g.	.125 to .062 mm (%)								
h.	.062 to .031 mm (%)								
i.	.031 to .016 mm (%)								
j.	.016 to .008 mm (%)								
k.	.008 to .004 mm (%)								
l.	.004 to .002 mm (%)								
m.	.002 to .001 mm (%)								
n.	<.001 mm (%)								
o.	Median Diameter (mm)	0.003	0.006	0.007	0.022	0.006	0.012	0.028	
p.	Sorting Coefficient	5.95	7.52	12.92	12.63	13.21	10.44	12.47	6.47
q.	Skewness	0.86	0.92	1.26	0.26	1.30	0.51	0.37	0.48
r.	Standard Deviation (mm)								
s.	Sediment Type	SLATEY CLAY	CLAYEY MUD	CLAYEY SAND	CLAYEY MUD	CLAYEY MUD	CLAYEY MUD	CLAYEY MUD	
t.	Dominant Minerals (%)								
u.	Secondary Minerals (%)								
v.	Calcium Carbonate (%)								
w.	Organic Carbon (%)								
15. REMARKS	Site #2								

CORE ANALYSIS SUMMARY SHEET
ENGINEERING PROPERTIES

MARCH 9 1963

ANALYZED BY Keller+Stiles

DATE 11 April 1963

NAVOCEANO-EXP-3167/18-B (Rev. 1-63)

1. CRUISE NO.	SUBSOME	4. SAMPLE NO.	BS-2	7. TYPE CORER	Hydroplastic
2. LATITUDE	30° 0' N	5. DATE TAKEN (day, month, year)	9 April 1963	8. CORE LENGTH (cm)	182.0
3. LONGITUDE	85° 42' W	6. WATER DEPTH (m)	8.8	9. CORER PENETRATION (cm)	300.0
10. SUBSAMPLE DEPTH IN CORE (cm)	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50
11. WET UNIT WEIGHT (g/cm³)					
12. SPECIFIC GRAVITY OF SOLIDS	2.42		2.48		2.49 2.50
13. WATER CONTENT (% dry weight)	440.5 -	379.8	324.9	210.7	234.9 219.1 174.3 208.3 183.4 173.2 186.9
14. VOID RATIO				7.95	5.82
15. SATURATED VOID RATIO				8.06	5.83
16. POROSITY (%)			88.8	85.3	81.8
17. LIQUID LIMIT					
18. PLASTIC LIMIT					
19. PLASTICITY INDEX					
20. LIQUIDITY INDEX					
21. COMPRESSION INDEX FROM LL					
22. COMPRESSIVE STRENGTH NATURAL (g/cm²) REMOULD (g/cm²)					
23. COHESION NATURAL (g/cm²) REMOULD (g/cm²)	0.8		9.8	18.3	23.9
24. SENSITIVITY			3.5	2.9	9.1
25. ANGLE OF INTERNAL FRICTION (°)			2.8	3.7	2.6
26. ACTIVITY					
27. MODULUS OF ELASTICITY					
28. SLUMP (%)					
29. REMARKS	Gravity Core, 200 lbs. no release mech. Site #2				

CORE ANALYSIS SUMMARY SHEET
ENGINEERING PROPERTIES

MAN. NO. 9005001

ANALYZED BY Keller & Stiles

DATE 11 April 1963

NAVOCEANO-EXP-3167/18-B (Rev. 1-63)

1. CRUISE NO. SUBSOME		4. SAMPLE NO. B5-2		7. TYPE CORER Hydrogeologic	
2. LATITUDE 30° 10' 10" N	3. LONGITUDE 85° 42' 31" W	5. DATE TAKEN (day, month, year) 9 April 1963	6. WATER DEPTH (m) 8.8	8. CORE LENGTH (cm) 182.0	9. CORER PENETRATION (cm) 300.0
10. SUBSAMPLE DEPTH IN CORE (cm)	11. WET UNIT WEIGHT (g/cm³)	12. SPECIFIC GRAVITY OF SOLIDS	13. WATER CONTENT (% dry weight)	14. VOID RATIO	15. SATURATED VOID RATIO
110	1.20	2.62	168.2	5.62	5.64
120	1.30	1.23	224.0	6.62	6.64
130	1.40	1.23	151.7	7.62	7.64
140	1.50	1.23	140.3	8.62	8.64
150	1.60	1.23	122.3	9.62	9.64
160	1.70	1.23	137.9	-	-
170	1.76	1.23	-	-	-
180	1.82	1.23	-	-	-
190	1.88	1.23	-	-	-
200	1.94	1.23	-	-	-
210	2.00	1.23	-	-	-
220	2.06	1.23	-	-	-
230	2.12	1.23	-	-	-
240	2.18	1.23	-	-	-
250	2.24	1.23	-	-	-
260	2.30	1.23	-	-	-
270	2.36	1.23	-	-	-
280	2.42	1.23	-	-	-
290	2.48	1.23	-	-	-
300	2.54	1.23	-	-	-
310	2.60	1.23	-	-	-
320	2.66	1.23	-	-	-
330	2.72	1.23	-	-	-
340	2.78	1.23	-	-	-
350	2.84	1.23	-	-	-
360	2.90	1.23	-	-	-
370	2.96	1.23	-	-	-
380	3.02	1.23	-	-	-
390	3.08	1.23	-	-	-
400	3.14	1.23	-	-	-
410	3.20	1.23	-	-	-
420	3.26	1.23	-	-	-
430	3.32	1.23	-	-	-
440	3.38	1.23	-	-	-
450	3.44	1.23	-	-	-
460	3.50	1.23	-	-	-
470	3.56	1.23	-	-	-
480	3.62	1.23	-	-	-
490	3.68	1.23	-	-	-
500	3.74	1.23	-	-	-
510	3.80	1.23	-	-	-
520	3.86	1.23	-	-	-
530	3.92	1.23	-	-	-
540	3.98	1.23	-	-	-
550	4.04	1.23	-	-	-
560	4.10	1.23	-	-	-
570	4.16	1.23	-	-	-
580	4.22	1.23	-	-	-
590	4.28	1.23	-	-	-
600	4.34	1.23	-	-	-
610	4.40	1.23	-	-	-
620	4.46	1.23	-	-	-
630	4.52	1.23	-	-	-
640	4.58	1.23	-	-	-
650	4.64	1.23	-	-	-
660	4.70	1.23	-	-	-
670	4.76	1.23	-	-	-
680	4.82	1.23	-	-	-
690	4.88	1.23	-	-	-
700	4.94	1.23	-	-	-
710	5.00	1.23	-	-	-
720	5.06	1.23	-	-	-
730	5.12	1.23	-	-	-
740	5.18	1.23	-	-	-
750	5.24	1.23	-	-	-
760	5.30	1.23	-	-	-
770	5.36	1.23	-	-	-
780	5.42	1.23	-	-	-
790	5.48	1.23	-	-	-
800	5.54	1.23	-	-	-
810	5.60	1.23	-	-	-
820	5.66	1.23	-	-	-
830	5.72	1.23	-	-	-
840	5.78	1.23	-	-	-
850	5.84	1.23	-	-	-
860	5.90	1.23	-	-	-
870	5.96	1.23	-	-	-
880	6.02	1.23	-	-	-
890	6.08	1.23	-	-	-
900	6.14	1.23	-	-	-
910	6.20	1.23	-	-	-
920	6.26	1.23	-	-	-
930	6.32	1.23	-	-	-
940	6.38	1.23	-	-	-
950	6.44	1.23	-	-	-
960	6.50	1.23	-	-	-
970	6.56	1.23	-	-	-
980	6.62	1.23	-	-	-
990	6.68	1.23	-	-	-
1000	6.74	1.23	-	-	-
1010	6.80	1.23	-	-	-
1020	6.86	1.23	-	-	-
1030	6.92	1.23	-	-	-
1040	6.98	1.23	-	-	-
1050	7.04	1.23	-	-	-
1060	7.10	1.23	-	-	-
1070	7.16	1.23	-	-	-
1080	7.22	1.23	-	-	-
1090	7.28	1.23	-	-	-
1100	7.34	1.23	-	-	-
1110	7.40	1.23	-	-	-
1120	7.46	1.23	-	-	-
1130	7.52	1.23	-	-	-
1140	7.58	1.23	-	-	-
1150	7.64	1.23	-	-	-
1160	7.70	1.23	-	-	-
1170	7.76	1.23	-	-	-
1180	7.82	1.23	-	-	-
1190	7.88	1.23	-	-	-
1200	7.94	1.23	-	-	-
1210	8.00	1.23	-	-	-
1220	8.06	1.23	-	-	-
1230	8.12	1.23	-	-	-
1240	8.18	1.23	-	-	-
1250	8.24	1.23	-	-	-
1260	8.30	1.23	-	-	-
1270	8.36	1.23	-	-	-
1280	8.42	1.23	-	-	-
1290	8.48	1.23	-	-	-
1300	8.54	1.23	-	-	-
1310	8.60	1.23	-	-	-
1320	8.66	1.23	-	-	-
1330	8.72	1.23	-	-	-
1340	8.78	1.23	-	-	-
1350	8.84	1.23	-	-	-
1360	8.90	1.23	-	-	-
1370	8.96	1.23	-	-	-
1380	9.02	1.23	-	-	-
1390	9.08	1.23	-	-	-
1400	9.14	1.23	-	-	-
1410	9.20	1.23	-	-	-
1420	9.26	1.23	-	-	-
1430	9.32	1.23	-	-	-
1440	9.38	1.23	-	-	-
1450	9.44	1.23	-	-	-
1460	9.50	1.23	-	-	-
1470	9.56	1.23	-	-	-
1480	9.62	1.23	-	-	-
1490	9.68	1.23	-	-	-
1500	9.74	1.23	-	-	-
1510	9.80	1.23	-	-	-
1520	9.86	1.23	-	-	-
1530	9.92	1.23	-	-	-
1540	9.98	1.23	-	-	-
1550	10.04	1.23	-	-	-
1560	10.10	1.23	-	-	-
1570	10.16	1.23	-	-	-
1580	10.22	1.23	-	-	-
1590	10.28	1.23	-	-	-
1600	10.34	1.23	-	-	-
1610	10.40	1.23	-	-	-
1620	10.46	1.23	-	-	-
1630	10.52	1.23	-	-	-
1640	10.58	1.23	-	-	-
1650	10.64	1.23	-	-	-
1660	10.70	1.23	-	-	-
1670	10.76	1.23	-	-	-
1680	10.82	1.23	-	-	-
1690	10.88	1.23	-	-	-
1700	10.94	1.23	-	-	-
1710	11.00	1.23	-	-	-
1720	11.06	1.23	-	-	-
1730	11.12	1.23	-	-	-
1740	11.18	1.23	-	-	-
1750	11.24	1.23	-	-	-
1760	11.30	1.23	-	-	-
1770	11.36	1.23	-	-	-
1780	11.42	1.23	-	-	-
1790	11.48	1.23	-	-	-
1800	11.54	1.23	-	-	-
1810	11.60	1.23	-	-	-
1820	11.66	1.23	-	-	-
1830	11.72	1.23	-	-	-
1840	11.78	1.23	-	-	-
1850	11.84	1.23	-	-	-
1860	11.90	1.23	-	-	-
1870	11.96	1.23	-	-	-
1880	12.02	1.23	-	-	-
1890	12.08	1.23	-	-	-
1900	12.14	1.23	-	-	-
1910	12.20	1.23	-	-	-
1920	12.26	1.23	-	-	-
1930	12.32	1.23	-	-	-
1940	12.38	1.23	-	-	-
1950	12.44	1.23	-	-	-
1960	12.50	1.23	-	-	-
1970	12.56	1.23	-	-	-
1980	12.62	1.23	-	-	-
1990	12.68	1.23	-	-	-
2000	12.74	1.23	-	-	-
2010	12.80	1.23	-	-	-
2020	12.86	1.23	-	-	-
2030	12.92	1.23	-	-	-
2040	12.98	1.23	-	-	-
2050	13.04	1.23	-	-	-
2060	13.10	1.23	-	-	-
2070	13.16	1.23	-	-	-
2080	13.22	1.23	-	-	-
2090	13.28	1.23	-	-	-
2100	13.34	1.23	-	-	-
2110	13.40	1.23	-	-	-
2120	13.46	1.23	-	-	-
2130	13.52	1.23	-	-	-
2140	13.58	1.23	-	-	-
2150	13.64	1.23	-	-	-
2160	13.70	1.23	-	-	-
2170	13.76	1.23	-	-	-
2180	13.82	1.23	-	-	-
2190	13.88	1.23	-	-	-
2200	13.94	1.23	-	-	-
2210	14.00	1.23	-	-	-
2220	14.06	1.23	-	-	-
2230	14.12	1.23	-	-	-
2240	14.18	1.23	-	-	-
2250	14.24	1.23	-	-	-
2260	14.30	1.23	-	-	-
2270	14.36	1.23	-	-	-
2280	14.42	1.23	-	-	-
2290	14.48	1.23	-	-	-
2300	14.54	1.23	-	-	-
2310	14.60	1.23	-	-	-
2320	14.66	1.23	-	-	-
2330	14.72	1.23	-	-	-
2340	14.78	1.23	-	-	-
2350	14.84	1.23	-	-	-
2360	14.90	1.23	-	-	-
2370	14.9				

CORE ANALYSIS SUMMARY SHEET
SEDIMENT SIZE AND COMPOSITION

MAY 19 1950 00 01

ANALYZED BY STEWART & LLOYD

DATE

AUG. 63

NAVOCANO-EXP-316/1B-A Rev. 1-63)

1. CRUISE NO.		SUBSOME		4. SAMPLE NO. BS-2		5. DATE TAKEN (DAY, MO., YR.)		6. WATER DEPTH (m)		7. TYPE CORER PVC-Hydroplastic		8. CORE LENGTH (cm)		9. CORER PENETRATION (cm)	
2. LATITUDE	30° 42'	10°	41°	"	N	"		8.8				182.0		300.	
3. LONGITUDE	85° 42'	10°	41°	"	W	"									
10. LABORATORY NUMBER	187-8	187-9	187-10	187-11	187-12	187-13	187-14	187-15					187-26	187-27	
11. SUBSAMPLE DEPTH IN CORE (cm)	0-10	25-30	30-40	46-56	80-90	120-130	150-160	176-182							
12. COLOR (GSA ROCK COLOR CHART) FIELD <input checked="" type="checkbox"/> LAB DETERMINATION	5Y2/1	5Y2/1	5Y2/1	5Y2/1	5Y2/1	5Y2/1	5Y2/1	5Y2/1					5Y2/1	5Y2/1	
13. ODOR	L	L	L	L	L	L	L	L					L	L	
14. SITE & COMPOSITION ANALYSIS													H ₂ S	H ₂ S	H ₂ S
a. > 4 mm (%)	1														
b. 4 to 2 mm (%)		1													
c. 2 to 1 mm (%)			1												
d. 1 to .500 mm (%)				1											
e. .500 to .250 mm (%)					1										
f. .250 to .125 mm (%)						1									
g. .125 to .062 mm (%)							6								
h. .062 to .031 mm (%)								4							
i. .031 to .016 mm (%)									2						
j. .016 to .008 mm (%)										8					
k. .008 to .004 mm (%)											15				
l. .004 to .002 mm (%)												12			
m. .002 to .001 mm (%)													12		
n. < .001 mm (%)														12	25
o. Median Diameter (mm)	0.003	0.003	0.004	0.005	0.006	0.007	0.009	0.006					0.040	0.007	
p. Sorting Coefficient	9.22	5.47	6.53	7.39	11.84	13.49	13.18	9.26					5.45	6.16	
q. Skewness	0.33	0.61	0.56	0.82	1.73	1.57	0.60	0.92					0.47	0.82	
r. Standard Deviation (mm)															
s. Sediment Type	SILT CLAY	SILT CLAY	SILT CLAY	SILT CLAY	SILT CLAY	SILT CLAY	SILT CLAY	SILT CLAY					SANDY MUD	SILTY MUD	
t. Dominant Minerals (%)															
u. Secondary Minerals (%)															
v. Calcium Carbonate (%)															
w. Organic Carbon															
15. REMARKS															

Site #2

CORE ANALYSIS SUMMARY SHEET
ENGINEERING PROPERTIES

ANALYZED BY Keller + Stiles
DATE 12 April 1963

NAVOCEANO-EXP-3167/18-B (Rev. 1-63)

1. CRUISE NO. SUBSONE	4. SAMPLE NO. B6-3	7. TYPE CORER Hydroplastic
2. LATITUDE 30° 10' S	5. DATE TAKEN (DAY, month, year) 9 April 1963	8. CORE LENGTH (cm) 221.0
3. LONGITUDE 86° 41' W	6. WATER DEPTH (m) 8.8	9. CORER PENETRATION (cm) 300.0
10. SUBSAMPLE DEPTH IN CORE (cm)	0 - 4	7-29
11. WET UNIT WEIGHT (g/cm ³)	2.39	29-39
12. SPECIFIC GRAVITY OF SOLIDS	2.39	39-59
13. WATER CONTENT (% dry weight)	433.1	59-67.5
14. VOID RATIO	-	67.5-77.5
15. SATURATED VOID RATIO	8.0	77.5-80
16. POROSITY (%)	8.38	80-90
17. LIQUID LIMIT	8.10	90-90
18. PLASTIC LIMIT	8.10	90-90
19. PLASTICITY INDEX	12.7	90-90
20. LIQUIDITY INDEX	-	90-90
21. COMPRESSION INDEX FROM LL		
22. COMPRESSIVE STRENGTH NATURAL (g/cm ²) REMOULD (g/cm ²)		
23. COHESION NATURAL (g/cm ²) REMOULD (g/cm ²)	2.8	10.5
24. SENSITIVITY		
25. ANGLE OF INTERNAL FRICTION (°)		
26. ACTIVITY	3.85	3.39
27. MODULUS OF ELASTICITY		
28. SLUMP (s)		
29. REMARKS Gravity Core, 200 lbs. no release mech. Site #2 * 10-15 cm, subsample depth in core.		

CORE ANALYSIS SUMMARY SHEET
ENGINEERING PROPERTIES

MUC 46005001
ANALYZED BY Keller & Sfiles
DATE 12 April 1963

NAVOCEANO-EXP-3167/18-B (Rev. 1-63)

1. CRUISE NO.	Subsome	4. SAMPLE NO.	BS-3	7. TYPE CORER	Hydroplastic
2. LATITUDE 30° 10' N	10° N	5. DATE TAKEN (day, month, year)	9 April 1963	8. CORE LENGTH (cm)	221.0
3. LONGITUDE 86° 12' W	86° 12' W	6. WATER DEPTH (m)	8.8	9. CORER PENETRATION (cm)	800.0
10. SUBSAMPLE DEPTH IN CORE (cm)	106.8 - 120	120 - 130	130 - 140	140 - 150	150 - 160
11. WET UNIT WEIGHT (g/cm³)	1.20	1.30	1.40	1.50	1.60
12. SPECIFIC GRAVITY OF SOLIDS	2.53			2.54	
13. WATER CONTENT (% dry weight)	195.1	179.0	139.0	141.8	-
14. VOID RATIO	4.60			5.04	
15. SATURATED VOID RATIO	4.53			5.07	
16. POROSITY (%)	82.1			83.4	
17. LIQUID LIMIT	109			143	
18. PLASTIC LIMIT	34			51	
19. PLASTICITY INDEX	75			92	
20. LIQUIDITY INDEX	193			162	
21. COMPRESSION INDEX FROM LL					
22. COMPRESSIVE STRENGTH ^a	NATURAL (g/cm²)	REMOULD (g/cm²)			
23. COHESION	NATURAL (g/cm²)	REMOULD (g/cm²)	26.7	35.2	41.5
			9.8	8.4	12.0
24. SENSITIVITY			2.7	4.2	3.5
25. ANGLE OF INTERNAL FRICTION (°)					
26. ACTIVITY			3.75	3.41	3.2
27. MODULUS OF ELASTICITY					
28. SLUMP (%)					
29. REMARKS					

CORE ANALYSIS SUMMARY SHEET
ENGINEERING PROPERTIES

McMurdo Sound 1
ANALYZED BY Keller & Shreve 1
DATE 12 April 1963

NAVOCEANO-EXP-3167/18-B (Rev. 1-63)

1. CRUISE NO.	SUBSOME	4. SAMPLE NO.	BS-3	7. TYPE CORER	Hydrosplastic
2. LATITUDE	30° 10' S	5. DATE TAKEN (Day, month, year)	9 April 1963	8. CORE LENGTH (cm)	221.0
3. LONGITUDE	86° 42' W	6. WATER DEPTH (m)	8.8	9. CORER PENETRATION (cm)	300.0
10. SUBSAMPLE DEPTH IN CORE (cm)	213.5 - 217.1				
11. WET UNIT WEIGHT (g/cm^3)					
12. SPECIFIC GRAVITY OF SOLIDS					
13. WATER CONTENT (% dry weight)	-				
14. VOID RATIO					
15. SATURATED VOID RATIO					
16. POROSITY (%)					
17. LIQUID LIMIT	118				
18. PLASTIC LIMIT	37				
19. PLASTICITY INDEX	81				
20. LIQUIDITY INDEX	139				
21. COMPRESSION INDEX FROM LL					
22. COMPRESSIVE STRENGTH NATURAL	(kg/cm^2)				
	REMOULD	(kg/cm^2)			
23. COHESION	NATURAL REMOULD	(kg/cm^2) (kg/cm^2)			
24. SENSITIVITY					
25. ANGLE OF INTERNAL FRICTION ($^\circ$)					
26. ACTIVITY					
27. MODULUS OF ELASTICITY					
28. SLUMP (in)					
29. REMARKS					

CORE ANALYSIS SUMMARY SHEET
SEDIMENT SIZE AND COMPOSITION

M.A. NO. 005001
ANALYZED BY STEWART + LLOYD

DATE AUG. 1963

NAVOCEANO-ERP-3167/18-A (Rev. 1-63)

1. CRUISE NO.		SUBSOME		4. SAMPLE NO. BS-3		7. TYPE CORER PVC - Hydroplastic		8. CORE LENGTH (cm) 221.0		9. CORE PENETRATION (cm) 300.0	
2. LATITUDE	30° 10'	10°	10°	5. DATE TAKEN (DAY, MO., YR.)	9 April 1963						
3. LONGITUDE	85° 42'	41'	" W	6. WATER DEPTH (m)	8.8						
10. LABORATORY NUMBER		187-16	187-17	187-18	187-19	187-20	187-21	187-22	187-23	187-24	187-28
11. SUBSAMPLE DEPTH IN CORE (cm)	0-9	10-15	29-39	49-57	80-90	120-130	150-160	180-190	203-213	212-221	Core Catcher
12. COLOR (GSA ROCK COLOR CHART) FIELD <input checked="" type="checkbox"/> LAB DETERMINATION	5Y3/2	5Y3/2	5Y2 1/2	5Y2 1/2	5Y3/2	5Y3/2	5Y3/2	5Y3/2	5Y3/2	5Y3/2	5Y3/2
13. ODOR	H2S	H2S	H2S	H2S	H2S	H2S	H2S	H2S	H2S	H2S	H2S
14. SITE & COMPOSITION ANALYSIS											
a. > 4 mm (%)											
b. 4 to 2 mm (%)											
c. 2 to 1 mm (%)											
d. 1 to .500 mm (%)											
e. .500 to .250 mm (%)											
f. .250 to .125 mm (%)											
g. .125 to .062 mm (%)											
h. .062 to .031 mm (%)											
i. .031 to .016 mm (%)											
j. .016 to .008 mm (%)											
k. .008 to .004 mm (%)											
l. .004 to .002 mm (%)											
m. .002 to .001 mm (%)											
n. < .001 mm (%)											
o. Median Diameter (mm)	0.003	0.004	0.003	0.003	0.018	0.037	0.067	0.015	0.018	0.022	0.019
p. Sorting Coefficient	4.57	4.45	4.40	4.08	11.31	8.64	10.90	6.47	7.13	7.47	7.50
q. Skewness	0.61	0.56	0.57	0.67	0.89	0.22	1.55	0.75	0.56	0.96	0.62
r. Standard Deviation (mm)											
s. Sediment Type	SAT CLAY SILTY CLAY SATURATED CLAY MUD SANDY CLAY MUD CLAY MUD										
t. Dominant Minerals (%)											
u. Secondary Minerals (%)											
v. Calcium Carbonate (%)	23	19	18	16	10	6	11	16	9	11	
w. Organic Carbon (%)	3.80	3.32	3.88	3.02	1.78	2.40	2.82	1.72	1.78	1.76	1.76
15. REMARKS Color change at 32 cm & 140 cm											

Site #2

CORE ANALYSIS SUMMARY SHEET
ENGINEERING PROPERTIES

MUCG 9005001
ANALYZED BY Keller & Stiles
DATE 13 April 1963

NAVOCEANO-EAP-3167/18-B (Rev. 1-63)

1. CRUISE NO. SUBSOME		4. SAMPLE NO. BS-4		7. TYPE CORER Hydroplastic	
2. LATITUDE 30° 09'	04" N	5. DATE TAKEN (day, month, year) 10 April 1963	6. WATER DEPTH (m) 8.8	8. CORE LENGTH (cm) 93.0	9. CORE PENETRATION (cm) 300.0
3. LONGITUDE 85° 02'	27" W	0-4	10-15	30-38	93-98
10. SUBSAMPLE DEPTH IN CORE (cm)			15-23	68-83	98-103
11. WET UNIT WEIGHT (g/cm ³)			22-38	83-93	103-113
12. SPECIFIC GRAVITY OF SOLIDS	2.53		1.85	1.39	1.37
13. WATER CONTENT (% dry weight)	306.2	194.4	-	2.67	2.58
14. VOID RATIO				3.58	2.57
15. SATURATED VOID RATIO				3.52	3.52
16. POROSITY (%)				3.20	3.62
17. LIQUID LIMIT				78.2	77.9
18. PLASTIC LIMIT					
19. PLASTICITY INDEX					
20. LIQUIDITY INDEX					
21. COMPRESSION INDEX FROM LL					
22. COMPRESSIVE STRENGTH NATURAL (g/cm ²)	1.4				
	REMOULD (g/cm ²)				
23. COHESION NATURAL (g/cm ²)	1.4		28.8	14.1	35.2
	REMOULD (g/cm ²)		9.1	2.8	12.0
24. SENSITIVITY			3.2	5.0	2.9
25. ANGLE OF INTERNAL FRICTION (°)					
26. ACTIVITY					
27. MODULUS OF ELASTICITY					
28. SLUMP (%)					
29. REMARKS	<i>Piston Core, 200 lbs. Site #1</i>				

CORE ANALYSIS SUMMARY SHEET
ENGINEERING PROPERTIES

NAVOCEANO-EXP-3167/1B-8 (Rev. 1-63)

ANALYZED BY Keflet & Stiles

DATE 13 April 1963

1. CRUISE NO.	2. LATITUDE	3. LONGITUDE	4. SAMPLE NO.	5. DATE TAKEN (day, month, year)	6. WATER DEPTH (m)	7. TYPE CORER	8. CORE LENGTH (cm)	9. CORER PENETRATION (cm)
1. CRUISE NO. SUBSOME	2. LATITUDE 30° 09' 04" N	3. LONGITUDE 05° 42' 27" W	4. SAMPLE NO. BS-4	5. DATE TAKEN (day, month, year) 10 April 1963	6. WATER DEPTH (m) 8.8	7. TYPE CORER Hydrexastic	8. CORE LENGTH (cm) 193.0	9. CORER PENETRATION (cm) 300.0
10. SUBSAMPLE DEPTH IN CORE (cm)	11. WET UNIT WEIGHT (g/cm³)	12. SPECIFIC GRAVITY OF SOLIDS	13. WATER CONTENT (%) dry weight)	14. VOID RATIO	15. SATURATED VOID RATIO	16. POROSITY (%)	17. LIQUID LIMIT	18. PLASTIC LIMIT
113.23	1.26	2.54	152.9	4.80	9.78	82.8		
128.33	1.23	2.54	188.2	219.8	202.3	83.9		
133.43	1.23	2.54	208.1	201.6	219.7	83.9		
148.53	1.23	2.54	213.1	201.6	219.7	83.9		
163.73	1.23	2.54	213.1	201.6	219.7	83.9		
173.73	1.23	2.54	213.1	201.6	219.7	83.9		
183.73	1.23	2.54	213.1	201.6	219.7	83.9		
193.73	1.23	2.54	213.1	201.6	219.7	83.9		
203.73	1.23	2.54	213.1	201.6	219.7	83.9		
213.73	1.23	2.54	213.1	201.6	219.7	83.9		
223.73	1.23	2.54	213.1	201.6	219.7	83.9		
233.73	1.23	2.54	213.1	201.6	219.7	83.9		
243.73	1.23	2.54	213.1	201.6	219.7	83.9		
253.73	1.23	2.54	213.1	201.6	219.7	83.9		
263.73	1.23	2.54	213.1	201.6	219.7	83.9		
273.73	1.23	2.54	213.1	201.6	219.7	83.9		
283.73	1.23	2.54	213.1	201.6	219.7	83.9		
293.73	1.23	2.54	213.1	201.6	219.7	83.9		

MOS 9005001

CORE ANALYSIS SUMMARY SHEET
SEDIMENT SIZE AND COMPOSITION

ANALYZED BY STEWART + LLOYDDATE AUG. 63

NOVOCANO-EXP-3167/16-A (Rev. 1-63)

1. CRUISE NO. SUBSOME		4. SAMPLE NO. BS-4		5. DATE TAKEN (DAY, MO., YR.) 10 APRIL 63		6. WATER DEPTH (m) 8.8		7. TYPE CORER PVC-Hydroplastic		8. CORE LENGTH (cm) 193.0		9. CORE PENETRATION (cm) 30.0	
2. LATITUDE	30° 09'	04"	N										
3. LONGITUDE	85° 42'	27"	W										
10. LABORATORY NUMBER	187-37	187-38		187-40	187-41A	187-41	187-42	187-43	187-44				
11. SUBSAMPLE DEPTH IN CORE (cm)	0-4	15-22	48-58	58-68	81.5-82	83-93	123-133	163-173	189-193				
12. COLOR (GSA ROCK COLOR CHART) FIELD <input checked="" type="checkbox"/> LAB DETERMINATION	5Y3/2	5Y2/1		5Y2/1	5Y2/1	5Y2/1	5Y3/2	5Y3/2	5Y3/2				
13. ODOR	L	L	L	L	L	L	L	L	L	L	L	H2S	
14. SIZE & COMPOSITION ANALYSIS													
a. > 4 mm (%)													
b. 4 to 2 mm (%)													
c. 2 to 1 mm (%)													
d. 1 to .500 mm (%)													
e. .500 to .250 mm (%)													
f. .250 to .125 mm (%)													
g. .125 to .062 mm (%)													
h. .062 to .031 mm (%)													
i. .031 to .016 mm (%)													
j. .016 to .008 mm (%)													
k. .008 to .004 mm (%)													
l. .004 to .002 mm (%)													
m. .002 to .001 mm (%)													
n. < .001 mm (%)	2.6	2.0	2.1	2.5	1.0	1.9	3.9	4.0	2.7	2.1	2.0		
o. Median Diameter (mm)	0.007	0.051	0.088	0.027	0.150	0.127	0.003	0.002	0.012	0.010	0.008		
p. Sorting Coefficient	1/2.8	2.03	9.00	12.52	2.02	9.23	15.3	11.6	9.23	4.18	5.39		
q. Skewness	2.59	0.12	0.04	0.22	0.36	0.02	1.04	1.35	0.59	0.70	0.45		
r. Standard Deviation (mm)													
s. Sediment Type													
t. Dominant Minerals (%)													
u. Secondary Minerals (%)													
v. Calcium Carbonate (%)													
w. Organic Carbon (%)													
15. REMARKS	Color change at 21 cm + 136 cm.												

Site #1

CORE ANALYSIS SUMMARY SHEET
ENGINEERING PROPERTIES

143 0 9 1 0 5 0 0 1

ANALYZED BY Keller & Stiles
DATE 15 April 1963

1. CRUISE NO. SUBSOME		4. SAMPLE NO. BS-5		7. TYPE CORER Hydroplastic	
2. LATITUDE 30° 09' 04"N	3. LONGITUDE 85° 42' 27"W	5. DATE TAKEN (DAY, month, year) 10 April 1963	6. CORE LENGTH (cm) 196.0	8. CORE LENGTH (cm) 355.0	
10. SUBSAMPLE DEPTH IN CORE (cm)	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50
11. WET UNIT WEIGHT (g/cm^3)				58.68	68.82
12. SPECIFIC GRAVITY OF SOLIDS				82.92	92.02
13. WATER CONTENT (%) dry weight)	-	156.9	126.1	138.7	145.7
14. VOID RATIO				1.41	1.24
15. SATURATED VOID RATIO				2.59	2.59
16. POROSITY (%)				2.59	
17. LIQUID LIMIT				3.39	5.62
18. PLASTIC LIMIT				3.59	5.60
19. PLASTICITY INDEX				77.2	84.9
20. LIQUIDITY INDEX					
21. COMPRESSION INDEX FROM LL					
22. COMPRESSIVE STRENGTH NATURAL (kg/cm^2)					
23. COHESION NATURAL (kg/cm^2)					
24. SENSITIVITY					
25. ANGLE OF INTERNAL FRICTION ($^\circ$)					
26. ACTIVITY					
27. MODULUS OF ELASTICITY					
28. SLUMP (%)					
29. REMARKS	Gravity core, 200 lbs. No free fall				
	Site #1				

A. 1 1 9 0 5 0 1

CORE ANALYSIS SUMMARY SHEET
ENGINEERING PROPERTIES

NAVOCEANO-EXP-3167/1B-B (Rev. 1-63)

1. CRUISE NO.	SUBSOME	4. SAMPLE NO.	BS-5	7. TYPE CORER	Hydroplastic
2. LATITUDE	30° 09' 04"N	5. DATE TAKEN (day, month, year)	10 April 1963	8. CORE LENGTH (cm)	196.0
3. LONGITUDE	85° 42' 27"W	6. WATER DEPTH (m)	8.8	9. CORER PENETRATION (cm)	355.00
10. SUBSAMPLE DEPTH IN CORE (cm)	122-132	11. WET UNIT WEIGHT (g/cm ³)	1.92-1.92	12. SPECIFIC GRAVITY OF SOLIDS	2.56
13. WATER CONTENT (% dry weight)	213.7	14. VOID RATIO	205.9	15. SATURATED VOID RATIO	222.4
16. POROSITY (%)	4.80	17. LIQUID LIMIT	192.1	18. PLASTIC LIMIT	171.7
19. PLASTICITY INDEX	4.92	20. LIQUIDITY INDEX	168.0	21. COMPRESSION INDEX FROM LL	153.6 / 17.0
22. COMPRESSIVE STRENGTH ^a	NATURAL REMOULD (g/cm ²)	23. COHESION NATURAL REMOULD (g/cm ²)	43.6	24. SENSITIVITY	5.6
26. ACTIVITY	7.7	25. ANGLE OF INTERNAL FRICTION (°)	27. MODULUS OF ELASTICITY	28. SLUMP (in)	29. REMARKS

CORE ANALYSIS SUMMARY SHEET
ENGINEERING PROPERTIES

M. 704050111
ANALYZED BY Keller & Stiles
DATE 14 April 1963

NAVOCEANO-EXP-3167/18-B (Rev. 1-63)

1. CRUISE NO. SUBSOME	4. SAMPLE NO. B5-6	7. TYPE CORER Hydroplastic
2. LATITUDE 30° 10' 27" N	5. DATE TAKEN (DAY, month, year) 10 April 1963	8. CORE LENGTH (cm) 300.0
3. LONGITUDE 85° 43' 49" W	6. WATER DEPTH (m) 11.6	9. CORER PENETRATION (cm) 300.0
10. SUBSAMPLE DEPTH IN CORE (cm)	0-5	0-50
11. WET UNIT WEIGHT (g/cm ³)	1.18	1.19
12. SPECIFIC GRAVITY OF SOLIDS	2.41	2.50
13. WATER CONTENT (% dry weight)	382.7	304.8
14. VOID RATIO	7.03	4.63
15. SATURATED VOID RATIO	7.06	4.75
16. POROSITY (%)	87.5	82.2
17. LIQUID LIMIT		
18. PLASTIC LIMIT		
19. PLASTICITY INDEX		
20. LIQUIDITY INDEX		
21. COMPRESSION INDEX FROM LL		
22. COMPRESSIVE STRENGTH NATURAL (g/cm ²) REMOULD (g/cm ²)		
23. COHESION NATURAL (g/cm ²) REMOULD (g/cm ²)	6.3	9.1
24. SENSITIVITY		
25. ANGLE OF INTERNAL FRICTION (°)		
26. ACTIVITY		
27. MODULUS OF ELASTICITY		
28. SLUMP (%)		
29. REMARKS	<i>Gravity core, 200 lbs. plus release mech.</i>	<i>Site #3</i>

CORE ANALYSIS SUMMARY SHEET
SEDIMENT SIZE AND COMPOSITION

ANALYZED BY STEWART & LLOYD

MAG 9005001

DATE AUG. 63

1. CRUISE NO. <u>SUBSOME</u>		4. SAMPLE NO. <u>B5-6</u>		7. TYPE CORER PVC- Hydroplastic	
2. LATITUDE <u>30° 10' N</u>		5. DATE TAKEN (DAY, MO., YR.) <u>10 April/ 63</u>		8. CORE LENGTH (cm) <u>101.0</u>	
3. LONGITUDE <u>43° 49' W</u>		6. WATER DEPTH (m) <u>11.6</u>		9. CORER PENETRATION (cm) <u>30.0</u>	
10. LABORATORY NUMBER		<u>187-54</u>		<u>187-56</u>	
11. SUBSAMPLE DEPTH IN CORE (cm)		<u>0-5</u>		<u>15-25</u>	
12. COLOR (GSA ROCK COLOR CHART)		<u>5Y2/1+</u>		<u>5Y2/1+ 5Y2/1+ 5Y2/1+ 5Y2/1+</u>	
13. FIELD <input checked="" type="checkbox"/> LAB DETERMINATION		<u>3/2</u>		<u>3/2 3/2 3/2 3/2</u>	
14. ODOR		<u>H2S</u>		<u>H2S H2S H2S H2S</u>	
14. SIZE & COMPOSITION ANALYSIS					
a.	> 4 mm (%)			1/4	
b. 4 to 2 mm (%)				TRACE /	
c. 2 to 1 mm (%)				1 / 1 / 2	
d. 1 to .500 mm (%)				2 / 2 / 7 / 6	
e. .500 to .250 mm (%)				5 / 15 / 10 / 19	
f. .250 to .125 mm (%)				2 / 9 / 21 / 10 / 23 / 18	
g. .125 to .062 mm (%)				2 / 4 / 4 / 2 / 3 / 3	
h. .062 to .031 mm (%)				1 / 9 / 10 / 9 / 9	
i. .031 to .016 mm (%)				1 / 8 / 10 / 9 / 9	
j. .016 to .008 mm (%)				1 / 7 / 23 / 12 / 12	
k. .008 to .004 mm (%)				2 / 3 / 17 / 8 / 8	
l. .004 to .002 mm (%)				1 / 13 / 16 / 8 / 8	
m. .002 to .001 mm (%)				1 / 22 / 18 / 10 / 9	
n. < .001 mm (%)				2 / 26 / 10 / 9	
o. Median Diameter (mm)	<u>.0002</u>	<u>.0002</u>		<u>.0005</u>	
p. Sorting Coefficient	<u>6.32</u>	<u>N.V.</u>		<u>6.96</u>	
q. Skewness	<u>0.40</u>	<u>N.V.</u>		<u>0.70</u>	
r. Standard Deviation (mm)					
s. Sediment Type	<u>SILT CLAY SILTY CLAY SANDY MUD CLAYEY MUD SILTY SAND</u>				
t. Dominant Minerals	<u>(S)</u>				
u. Secondary Minerals	<u>(S)</u>				
v. Calcium Carbonate (%)	<u>(S)</u>				
w. Organic Carbon (%)	<u>(S)</u>				
15. REMARKS					

Site #3

CORE ANALYSIS SUMMARY SHEET
ENGINEERING PROPERTIES

NAVOCEANO-EXP-3167/1B-8 (Rev. 1-63)

ANALYZED BY Keller & Stiles

DATE 15 April 1963

1. CRUISE NO. SUBSOME	4. SAMPLE NO. BS-7	7. TYPE CORER Hydropastic
2. LATITUDE 30° 10' 17" N	5. DATE TAKEN (day, month, year) 10 April 1963	8. CORE LENGTH (cm) 102.0
3. LONGITUDE 86° 44' 12" W	6. WATER DEPTH (m) 11.9	9. CORER PENETRATION (cm) 300.0
10. SUBSAMPLE DEPTH IN CORE (cm)	0 - 5 5 - 15 15 - 25 25 - 35 35 - 42 42 - 52 52 - 62 62 - 72 72 - 82 82 - 92 92 - 102	
11. WET UNIT WEIGHT (g/cm ³)	1.35	1.37
12. SPECIFIC GRAVITY OF SOLIDS	2.61	2.62
13. WATER CONTENT (% dry weight)	248.8 190.9 216.5 139.6 114.6 116.4 124.5 -	128.9 129.2 120.9
14. VOID RATIO	3.65	3.30
15. SATURATED VOID RATIO	3.64	3.26
16. POROSITY (%)	78.5	76.7
17. LIQUID LIMIT		
18. PLASTIC LIMIT		
19. PLASTICITY INDEX		
20. LIQUIDITY INDEX		
21. COMPRESSION INDEX FROM LL		
22. COMPRESSIVE STRENGTH NATURAL (g/cm ²) REMOULD (g/cm ²)	12.0	21.8
23. COHESION NATURAL (g/cm ²) REMOULD (g/cm ²)	7.7	4.9
24. SENSITIVITY	1.5	4.4
25. ANGLE OF INTERNAL FRICTION (°)		
26. ACTIVITY		
27. MODULUS OF ELASTICITY		
28. SLUMP (%)		
29. REMARKS	<i>Gravity Core, 200 lbs. No free fall Site #4</i>	

CORE ANALYSIS SUMMARY SHEET
ENGINEERING PROPERTIES

1A-309005001

ANALYZED BY Keller & Stiles

DATE 15 April 1963

NAVOCEANO-EXP-3167/18-B (Rev. 1-63)

1. CRUISE NO.	SUBSOME	4. SAMPLE NO.	BS-7	7. TYPE CORER	Hydrexastic
2. LATITUDE	30° 10' N	5. DATE TAKEN (Day, month, year)	10 April 1963	8. CORE LENGTH (cm)	187.0
3. LONGITUDE	122° W	6. WATER DEPTH (m)	11.9	9. CORE PENETRATION (cm)	300.0
10. SUBSAMPLE DEPTH IN CORE (cm)	107.5	11. WET UNIT WEIGHT (g/cm³)	1.03	12. SPECIFIC GRAVITY OF SOLIDS	
11. WET UNIT WEIGHT (g/cm³)	1.03	13. WATER CONTENT (% dry weight)	120.0	14. VOID RATIO	
12. SPECIFIC GRAVITY OF SOLIDS		13. WATER CONTENT (% dry weight)	98.4	15. SATURATED VOID RATIO	
14. VOID RATIO		14. VOID RATIO	94.7	16. POROSITY (%)	
15. SATURATED VOID RATIO		15. SATURATED VOID RATIO	84.9	17. LIQUID LIMIT	
16. POROSITY (%)		16. POROSITY (%)	86.2	18. PLASTIC LIMIT	
17. LIQUID LIMIT		17. LIQUID LIMIT	83.9	19. PLASTICITY INDEX	
18. PLASTIC LIMIT		18. PLASTIC LIMIT	104.8	20. LIQUIDITY INDEX	
19. PLASTICITY INDEX		19. PLASTICITY INDEX	112.1	21. COMPRESSION INDEX FROM LL	
20. LIQUIDITY INDEX		20. LIQUIDITY INDEX	118.2	22. COMPRESSIVE STRENGTH ^a NATURAL (g/cm²)	
21. COMPRESSION INDEX FROM LL		21. COMPRESSION INDEX FROM LL		22. COMPRESSIVE STRENGTH ^a REMOLD (g/cm²)	
22. COMPRESSIVE STRENGTH ^a NATURAL (g/cm²)		22. COMPRESSIVE STRENGTH ^a NATURAL (g/cm²)		23. COHESION NATURAL (g/cm²)	42.1
REMOLD (g/cm²)		REMOLD (g/cm²)		REMOLD (g/cm²)	9.1
24. SENSITIVITY		24. SENSITIVITY			5.2
25. ANGLE OF INTERNAL FRICTION (°)		25. ANGLE OF INTERNAL FRICTION (°)			
26. ACTIVITY		26. ACTIVITY			
27. MODULUS OF ELASTICITY		27. MODULUS OF ELASTICITY			
28. SLUMP (%)		28. SLUMP (%)			
29. REMARKS		29. REMARKS			

CORE ANALYSIS SUMMARY SHEET
ENGINEERING PROPERTIES

MC-711 (Mallard) SKY D-4 Shales

NAVOCEANO-EXP-3167/1B-B (Rev. 1-63)

DATE 14 April 1963

1. CRUISE NO.	SUBSONE	4. SAMPLE NO.	BS - 8	7. TYPE CORER	Hydroplastic
2. LATITUDE	30° 10'	5. DATE TAKEN (D.M.Y.)	10 April 1963	8. CORE LENGTH (cm)	231.5
3. LONGITUDE	85° 12' W	6. WATER DEPTH (m)	11.9	9. CORE PENETRATION (cm)	285.0
10. SUBSAMPLE DEPTH IN CORE (cm)	0 - 3	7 - 16	16 - 37	37 - 68	68 - 90
11. WET UNIT WEIGHT (g/cm³)				1.37	1.35
12. SPECIFIC GRAVITY OF SOLIDS				2.56	2.57
13. WATER CONTENT (% dry weight)	289.2	193.4	182.2	129.8	121.6
14. VOID RATIO		3.89		3.45	3.19
15. SATURATED VOID RATIO		3.89		3.53	3.21
16. POROSITY (%)		79.6		77.5	76.1
17. LIQUID LIMIT					
18. PLASTIC LIMIT					
19. PLASTICITY INDEX					
20. LIQUIDITY INDEX					
21. COMPRESSION INDEX FROM LL					
22. COMPRESSIVE STRENGTH NATURAL (g/cm²) REMOULD (g/cm²)					
23. COHESION NATURAL (g/cm²) REMOULD (g/cm²)	9.8		35.9	30.9	
24. SENSITIVITY	3.5		5.6	7.7	
25. ANGLE OF INTERNAL FRICTION (°)	2.8		6.4	9.0	
26. ACTIVITY					
27. MODULUS OF ELASTICITY					
28. SLUMP (in)					
29. REMARKS	Piston Core, 200 lbs. Site #4				

CORE ANALYSIS SUMMARY SHEET
ENGINEERING PROPERTIES

MGG 0 9 0 0 5 0 0 1
ANALYZED BY Keller & Stiles

NAVOCEANO-EXP-3167/18-B (Rev. 1-63)

DATE 14 April 1963

1. CRUISE NO.	2. LATITUDE	3. LONGITUDE	4. SAMPLE NO.	5. DATE TAKEN (DAY, month, year)	6. WATER DEPTH (m)	7. TYPE CORER	8. CORE LENGTH (cm)	9. CORE PENETRATION (cm)
SUBSOME	30° 10'	12° N	BS-8	11. 9	129	Hydroplastic	231.5	285.0
					139			
					149			
					158			
					168			
					178			
					187			
					197			
					207			
					217			
					227			
					237			
					247			
					257			
					267			
					277			
					287			
					297			
					307			
					317			
					327			
					337			
					347			
					357			
					367			
					377			
					387			
					397			
					407			
					417			
					427			
					437			
					447			
					457			
					467			
					477			
					487			
					497			
					507			
					517			
					527			
					537			
					547			
					557			
					567			
					577			
					587			
					597			
					607			
					617			
					627			
					637			
					647			
					657			
					667			
					677			
					687			
					697			
					707			
					717			
					727			
					737			
					747			
					757			
					767			
					777			
					787			
					797			
					807			
					817			
					827			
					837			
					847			
					857			
					867			
					877			
					887			
					897			
					907			
					917			
					927			
					937			
					947			
					957			
					967			
					977			
					987			
					997			
					1007			
					1017			
					1027			
					1037			
					1047			
					1057			
					1067			
					1077			
					1087			
					1097			
					1107			
					1117			
					1127			
					1137			
					1147			
					1157			
					1167			
					1177			
					1187			
					1197			
					1207			
					1217			
					1227			
					1237			
					1247			
					1257			
					1267			
					1277			
					1287			
					1297			
					1307			
					1317			
					1327			
					1337			
					1347			
					1357			
					1367			
					1377			
					1387			
					1397			
					1407			
					1417			
					1427			
					1437			
					1447			
					1457			
					1467			
					1477			
					1487			
					1497			
					1507			
					1517			
					1527			
					1537			
					1547			
					1557			
					1567			
					1577			
					1587			
					1597			
					1607			
					1617			
					1627			
					1637			
					1647			
					1657			
					1667			
					1677			
					1687			
					1697			
					1707			
					1717			
					1727			
					1737			
					1747			
					1757			
					1767			
					1777			
					1787			
					1797			
					1807			
					1817			
					1827			
					1837			
					1847			
					1857			
					1867			
					1877			
					1887			
					1897			
					1907			
					1917			
					1927			
					1937			
					1947			
					1957			
					1967			
					1977			
					1987			
					1997			
					2007			
					2017			
					2027			
					2037			
					2047			
					2057			
					2067			
					2077			
					2087			
					2097			
					2107			
					2117			
					2127			
					2137			
					2147			
					2157			
					2167			
					2177			
					2187			
					2197			
					2207			
					2217			
					2227			
					2237			
					2247			
					2257			
					2267			
					2277			
					2287			
					2297			
					2307			
					2317			
					2327			
					2337			
					2347			
					2357			
					2367			
					2377			
					2387			
					2397			
					2407			
					2417			
					2427			
					2437			
					2447			
					2457			
					2467			
					2477			
					2487			
					2497			
					2507			
		</						

CORE ANALYSIS SUMMARY SHEET
SEDIMENT SIZE AND COMPOSITION

ANALYZED BY STEWART + KLOYD

NAVOCANO-EXP-31678-A Rev. 1-63)

DATE AUG. 63

1. CRUISE NO. <u>SUBSOME</u>		4. SAMPLE NO. <u>BS-8</u>		5. DATE TAKEN (DAY, MO., YR.) <u>10 April/ 63</u>		6. WATER DEPTH (m) <u>11. 9</u>		7. TYPE CORER PVC-Hydroplastic		8. CORE LENGTH (cm) <u>231.5</u>		9. CORE PENETRATION (cm) <u>285.</u>	
2. LATITUDE <u>30° 10'</u>	3. LONGITUDE <u>85° 44'</u>	4. LATITUDE <u>17° N</u>	5. LONGITUDE <u>72° W</u>	6. WATER DEPTH (m)	7. TYPE CORER PVC-Hydroplastic	8. CORE LENGTH (cm)	9. CORE PENETRATION (cm)	10. LABORATORY NUMBER	11. SUBSAMPLE DEPTH IN CORE (cm)	12. COLOR (GSA ROCK COLOR CHART)	13. FIELD LAB DETERMINATION	14. ODOR	
<u>187-25</u>	<u>187-46</u>	<u>187-47</u>	<u>187-48</u>	<u>187-49</u>	<u>187-50</u>	<u>187-51</u>	<u>187-52</u>	<u>187-53</u>	<u>187-54</u>	<u>187-55</u>	<u>187-56</u>	<u>H₂S</u>	
<u>0-4</u>	<u>16-26</u>	<u>47-58</u>	<u>80-90</u>	<u>119-129</u>	<u>158-168</u>	<u>199-209</u>	<u>207-218</u>	<u>218-229</u>	<u>227-235</u>	<u>237-245</u>	<u>247-254</u>	<u>core cutter</u>	
<u>SY2/1</u>	<u>SY2/1</u>	<u>SY2/1</u>	<u>SY2/1</u>	<u>SY2/1</u>	<u>SY2/1</u>	<u>SY2/1</u>	<u>SY2/1</u>	<u>SY2/1</u>	<u>SY2/1</u>	<u>SY2/1</u>	<u>SY2/1</u>	<u>SY2/1</u>	
<u>L</u>	<u>L</u>	<u>L</u>	<u>L</u>	<u>L</u>	<u>L</u>	<u>L</u>	<u>L</u>	<u>L</u>	<u>L</u>	<u>L</u>	<u>L</u>	<u>L</u>	
<u>H₂S</u>	<u>H₂S</u>	<u>H₂S</u>	<u>H₂S</u>	<u>H₂S</u>	<u>H₂S</u>	<u>H₂S</u>	<u>H₂S</u>	<u>H₂S</u>	<u>H₂S</u>	<u>H₂S</u>	<u>H₂S</u>	<u>H₂S</u>	
<u>14. SIZE & COMPOSITION ANALYSIS</u>													
a. <u>4 mm (1%)</u>													
b. .4 to 2 mm (%)													
c. 2 to 1 mm (%)													
d. 1 to .500 mm (%)													
e. .500 to .250 mm (%)													
f. .250 to .125 mm (%)													
g. .125 to .062 mm (%)													
h. .062 to .031 mm (%)													
i. .031 to .016 mm (%)													
j. .016 to .008 mm (%)													
k. .008 to .004 mm (%)													
l. .004 to .002 mm (%)													
m. .002 to .001 mm (%)													
n. <.001 mm (%)													
o. Median Diameter (mm)	<u>2.3</u>	<u>16</u>	<u>15</u>	<u>17</u>	<u>13</u>	<u>10</u>	<u>19</u>	<u>24</u>	<u>24</u>	<u>27</u>			
p. Sorting Coefficient	<u>0.010</u>	<u>0.075</u>	<u>0.077</u>	<u>0.045</u>	<u>0.093</u>	<u>0.060</u>	<u>0.011</u>	<u>0.007</u>	<u>0.008</u>	<u>0.006</u>			
q. Skewness	<u>1.04</u>	<u>7.26</u>	<u>5.11</u>	<u>6.63</u>	<u>4.03</u>	<u>4.89</u>	<u>4.47</u>	<u>5.00</u>	<u>5.20</u>	<u>4.59</u>			
r. Standard Deviation (mm)	<u>1.22</u>	<u>0.85</u>	<u>0.16</u>	<u>0.21</u>	<u>0.23</u>	<u>0.66</u>	<u>0.51</u>	<u>0.42</u>	<u>0.38</u>				
s. Sediment Type													
t. Dominant Minerals (%)													
u. Secondary Minerals (%)													
v. Calcium Carbonate (%)													
w. Organic Carbon (%)													
x. REMARKS Color change at 58 cm.													
15. REMARKS													

Site #4